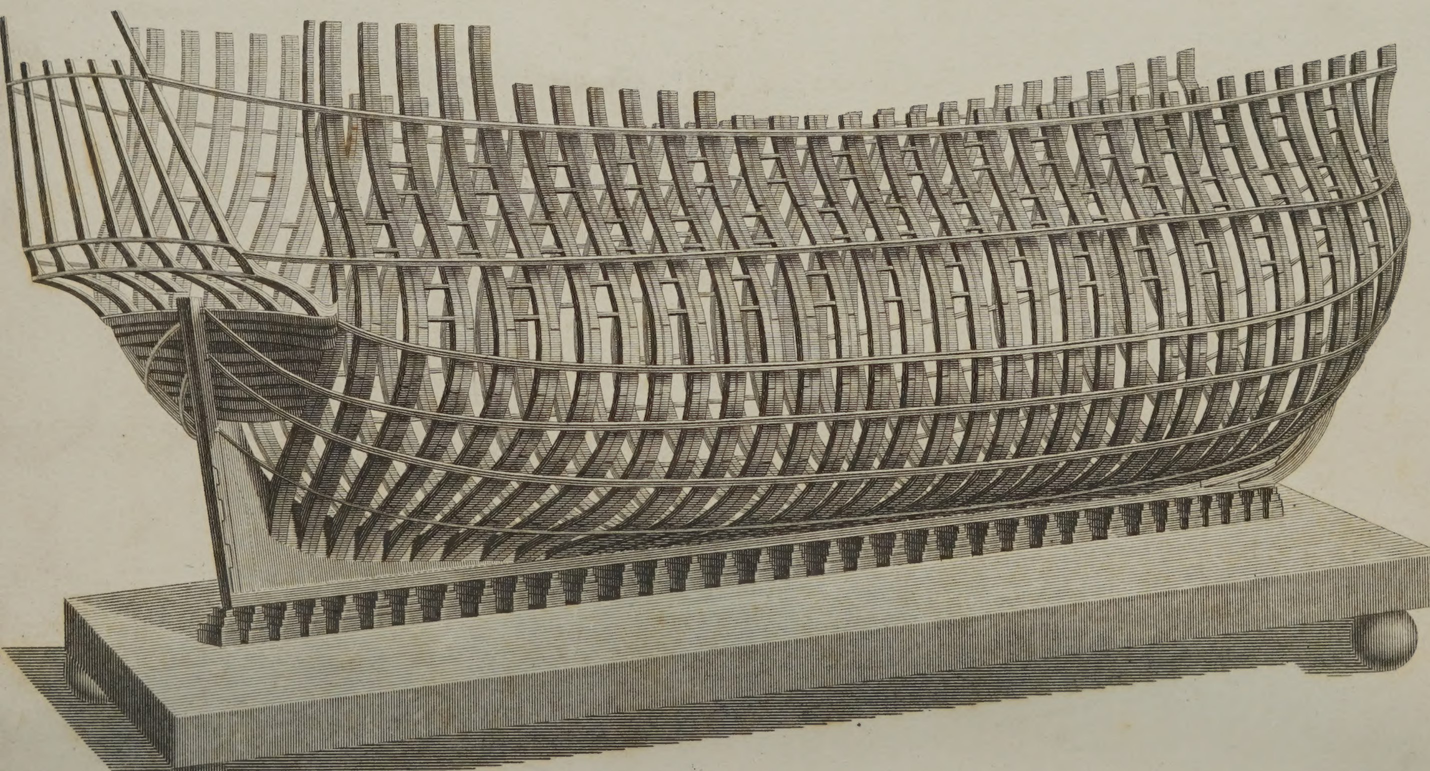
Perspective Appearance of the Frame Timbers
of a
HUNDRED GUN SHIP.



PREFACE.

In the navy of Britannia consists her strength, her greatness, and her glory; it may therefore seem remarkable that we have never yet had, in the English language, a treatise on Naval Architecture, calculated to convey, to her sons, a general knowledge of the science; especially, as such a treatise has long been a desideratum in the British Islands. For, although several works have already been published upon the subject, yet they were executed when the art was in its infant state; and when its fundamental principles were either misunderstood or very imperfectly known.

It is, nevertheless, to be admitted, that the art has, occasionally, at different periods, attracted the notice, and engrossed the attention, of several characters of the first eminence in mathematical literature; particularly on the Continent: it is, however, no less true, that these authors have, generally, confined their researches to the theory, leaving the practice, either wholly unnoticed, or but very imperfectly explained. In both, they seem to have been, with an individual exception *, equally unsuccessful.

The writers of our own country, few in number, have, on the other hand, confined themselves to the PRACTICE, leaving the theory, then imperfectly understood, either totally unnoticed, or, at least, erroneously described.

Of the writers on the subject, both in our own and foreign countries, the general observation has been, either, that they have treated the subject in too scholastic, or in too superficial a manner; that they have treated of it partially, rather than

* The illustrious Chapman, of Sweden, whose works, if translated, would, however, be of little value in this country; since they are not to be understood without a previous acquaintance with the higher branches of the mathematics, of which very little is known among our artists.

generally; and that their more ingenious disquisitions have been calculated rather to amuse than to instruct; and, sometimes, to mislead rather than to inform.

These considerations led to the projection of the present work: a work, which, we trust, will be found to develope, in the plainest and most familiar manner, all the rudiments of Naval Architecture; together with such a collection of interesting information, relative to the different subjects immediately connected with the science, as have never before appeared.

It has been in a progressive state for some years; and the result, at the close of this protracted period, is before our country; comprehending, with the *Elements* and *Practice* of *Rigging* and *Seamanship*, executed in one uniform style, a complete circle of all those sciences, connected with the building, rigging, and working of a ship.

Some years have now elapsed, since, after an arduous labour of several preceding years, the public was presented with the "*Elements* and *Practice* of *Rigging* and *Seamanship*," above mentioned, in two volumes, quarto; a work, whose practical and extensive utility has since been generally acknowledged by all the nautical world; throughout which it speedily obtained a rapid and general circulation.

The encouragement thus given to that work, immediately after its first appearance, united with our foregoing considerations, induced my late father and myself to extend our views to the execution of this.

The objects which impeded the completion of the former work have been distinctly stated in its preface. In that preface, my late respected father, its foster-parent, explained the means which he employed to perfect it in all the branches of the various subjects which it embraces. The same means, the same care, industry, and attention, have been employed for the completion of the present work.

" Actual workmen in the different branches have been necessarily consulted;
" and their differing methods required comparison by others, in order that the
" correct principles might be established, and the best practice explained. The
" disinclination of many to be open in their communications, from the possession

"of supposed secrets, has often opposed its advancement, and often chilled the "ardour of our perseverance." For several successive years, as they elapsed, our difficulties seemed to increase; but, with those difficulties, there arose the greater necessity for the result of our labours: and this circumstance operated as an additional stimulus to our diligence.

It is well-known that the number of our draughtsmen is rapidly diminishing; and few are rising to supply the vacancy. May we not then be permitted to indulge a reasonable hope, that our work, thus rendered doubly necessary, will be the means, in great measure, of supplying the deficiency; and of preserving one of the most important arts of our country from deterioration? Nay, farther, that the means of improving the Navy of Great Britain, together with her commercial advantages, will be considerably increased by our labours.

The Work is divided into Two Books, of which the First comprizes an explanation of Terms, and of the first elementary and theoretic principles: the Second is entirely practical, and comprehends the Rules for the construction of all the different classes of Shipping, with the Tables of Dimensions, &c.

The treatise commences with an explanation of the Terms, and of some elementary principles essentially requisite to be understood by the young artist before he proceeds to the subsequent part of the work. These will be found by far more copious and numerous than in any former publication: for, of the phrases strictly confined to *ship-building*, many, very many, have hitherto passed unnoticed by all preceding writers; and even many of those which have been noticed, have been so superficially explained as to convey but a very imperfect idea of their real import. It has been our study to supply this defect: nor have we confined ourselves within the narrow limits by which the subject would appear to be circumscribed. We have given every technical term made use of in the course of the work with which it is *possible* that the young beginner may be unacquainted. Hence a number of those which properly appertain to the sciences of geometry, hydrostatics, and mechanics, may be found; as they are occasionally referred to in the course of the treatise, and as the insertion of them may save the reader the trouble of referring to different books.

In the second chapter, of the first book, we treat of fluids and their action on solid bodies, as investigated by actual experiment.—This division of the subject commences with a brief explanation of the nature of fluids, and of the general principles of hydrostatics, preparatory to a description of the Experiments which have been made, both in England and France, for the determination of the resistance of floating bodies. Then follows a description of those experiments; with general observations on vessels calculated to sail with great velocity, including, as an experimented body, a description of the Flying Proa of the Ladrone Islands.

In this Chapter will be found a full and precise account of the series of Experiments made, a few years since, under the direction of the patriotic Society instituted at London for the Improvement of Naval Architecture, for the purpose of ascertaining the quantity, means, and causes of resistance, of all the variety of floating bodies. We have been the more particular in giving the detail of these experiments, inasmuch as they must, although so recently made, be ever considered as the origin of the true theory of ship-building, and as the incontrovertible mean of confuting those specious, but fallacious reasonings, which had so long deceived the constructors of shipping, and so long retarded the progress and perfection of the science.

The mode of arrangement which we have adopted in this section will, we trust, be found particularly clear and satisfactory. The result of all the experiments will be found comprized on a single page, and the figures of the bodies on a single plate; thereby illustrative of each other.

The Experiments of Charles Gore, Esq. and the other experiments which follow, in the same chapter, may be considered as of the first importance in elucidating the best forms of vessels in general, and especially of those which are more particularly adapted to velocity. In both these and the former experiments, the great necessity of attending to the peculiar figure or conformation both of the head and stern of every vessel, together with the true position of the midship-bend, may be clearly seen. By these also, the advantages and disadvantages of a certain degree of leanness or fullness, in any part of a ship's body, are clearly pointed out and established.

We next proceed to the application of those principles in the construction of Shipping; and, in Chap. III. it will be found that we have pointed out the best methods of imparting to vessels of every description those peculiar qualities which it is most desirable for them respectively to possess. The means of forming them, so as to obtain the figure best adapted to velocity, having been explained in the preceding chapter, we here, after premising some necessary definitions, particularly applicable to this part of the subject, shew how a ship should be formed so as to possess a sufficient degree of stability or stiffness, the first grand quality required in every vessel destined to traverse the ocean; we then proceed to shew how all the other qualities contributive to a vessel's excellency are to be obtained, and how far the qualities subversive of each other can be practically combined.

In this Chapter we have incorporated a very valuable paper on the construction of ships, written by Sir George Shee, Bart. Member of the Royal Irish Academy. The intrinsic value of the observations contained in this paper will be obvious; since they correspond in principle with the most accurate experiments, and accord with the opinions of the best-informed judges of the subject.

To the foregoing have been added a few remarks on the formation of merchant-shipping, by the late ingenious Mr. W. Hutchinson; which may, probably, be found useful to those who more particularly desire to be accurately acquainted with that branch of the art.

The leading design of this chapter, in the developement of *principle*, is still farther continued in the Explanation of the particular advantages of vessels constructed with sliding keels, and other Improvements, introduced by John Schank, Esq. Captain in the Royal Navy, &c. The knowledge of these advantages has been so fully confirmed by experience, as to require but little of our commendation. We are aware that some objections have been made to the practice of this very useful invention; but, as the principle is manifestly of great utility, we hope to see it continued, improved, and extended.

The remarks which follow, on the different classes of British shipping, will be found at once to exemplify the principles before laid down, and to point out the prevailing excellencies and defects in the various descriptions of vessels appertaining to Great Britain, both in the Royal Navy and in the Merchant-service. Here will also be found a particular description of Boats, including the Life-Boat, the invaluable invention of Mr. Greathead, of South Shields; together with a description of the new sloops of war on the construction lately invented by Samuel objectionable. In order to render these observations more generally useful and acceptable, we have pointed out those parts wherein the knowledge and judgement of the ingenious author appear to have been defective; and have taken the liberty to subjoin such notes as seemed requisite to correct all those parts which bear the semblance of prejudice or misinformation.

The explanation of Mr. Seppings's new and very superior method of docking ships, having never before appeared in print, will prove, we doubt not, extremely acceptable.

The remarks upon a ship's hogging, and the methods of prevention; the papers on the means of recovering foundered and stranded ships, with the description of the machines for driving and drawing ships' bolts; formed necessary parts of our plan, in order to comprehend all the useful information which could tend to increase the utility and value of the work.

The concluding section comprizes observations upon timber, with rules for its admeasurement, and for its conversion into the different figures which enter into the composition of a ship, together with tables of its value at the time our manuscript was sent to press. This section, we presume, will, therefore, be found of considerable value to many persons employed in the purveying of timber for ship-building, and of all who desire to become acquainted with the most correct rules for its admeasurement and conversion.

The Tables of the Dimensions of ships' bodies, which follow, are far more copious and complete than any other that have heretofore appeared; and they consist entirely of the dimensions of those ships, which, upon trial, have merited a decided preference.

Lastly, the Tables of the Dimensions and Scantlings of Ships and Vessels of every class, which are placed at the end of the volume, for the greater convenience of reference, belong to the ships above-mentioned. These tables are accompanied with such directions as are necessary to the practical explanation of them, and they will be found of high utility and value, as their accuracy may be relied on. Nor are they confined merely to the dimensions and scantlings, but comprize also *the weight of all the iron work*, &c. generally used, and of which no account has ever hitherto been communicated to the public.

These tables alone occupied, for a considerable period, the time and attention of several persons who devoted to them the fruits of a long experience: they will consequently be found particularly valuable to the ship-builder, in the formation of his estimates, which may, by their means, be computed to an unexampled degree of nicety.

Annexed to the Tables is the Form of a Contract entered into by a merchant-builder, for building a ship of war for the Royal Navy; including the dimensions of the new brigs of war, built on the improved construction of the year 1804.

To the latter is subjoined a complete Index to the Tables, by means of which the Reader may instantly refer to any particular contained therein. This index will be found to facilitate, very considerably, the construction of any draught or plan from the given dimensions.

The Draughts and Engravings which illustrate the whole have been drawn and engraved with the utmost care; and form a collection, which will be found, especially to the younger artists, of the highest consequence and value; since they are those of ships and vessels which stand in the very first rank in their respective classes. They are such, we may venture to say, as, collectively, are not to be met with in any private assemblage of draughts in this country, nor, perhaps, to be equalled in the world.

In this one work, therefore, may be found all that can be required by the novice, for his instruction, and by the adept, for his practice, in this important art. As our theory is not that of doubtful speculation, but of absolute experiment, its principles are incontrovertible. Our practice is that of the most experienced and best informed artists of these kingdoms, hitherto unrivalled in the practical construction of ships. We rejoice that it can no longer be said with truth, that " there are no fixed and positive principles established by demonstration and confirmed by use;" or, " that there is hardly a rule sanctified by common consent:" since, as we trust, the reverse will appear to be the case in the present Treatise.

The unremitted assiduity of those professional Gentlemen, to whom I gratefully acknowledge myself indebted for their assistance, combined with my own exertions, have at length matured the following sheets, and accomplished the object of our enterprise. It is now submitted to the inspection of a liberal and discriminating Public; and I trust, that the expense and care, of which every part affords conspicuous proofs, will justify us from the imputation of presumption, in awaiting, with some degree of confidence, the patronage of all who are anxious for the advancement of a science, so highly contributory to the exaltation of the national influence and prosperity.

Should its circulation prove these expectations to be founded on the solid basis of meritorious accomplishment, the exertions of diligent research and laborious application will have met with an honourable and ample recompense.

DAVID STEEL.

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ENGRAVINGS.

THE smaller Engravings, exclusive of the Frontispiece, are distinguished by Letters of the Alphabet, from A to I, and are placed at the End of the Volume. These consist of

THE LARGER DRAUGHTS ARE AS FOLLOW.

*** The Plates of Laying-off are all on the same Scale as the Draughts above mentioned of the Eighty-gun Ship.

THE

ELEMENTS AND PRACTICE

OF

NAVAL ARCHITECTURE.

BOOK THE FIRST.

EXPLAINING THE FIRST ELEMENTARY AND THEORETIC PRINCIPLES.

CHAPTER I.

AN EXPLANATION OF THE TERMS, AND OF SOME ELEMENTARY PRINCIPLES, REQUISITE TO BE UNDERSTOOD IN THE THEORY AND PRACTICE OF SHIP-BUILDING.

ABAFT. The hinder part of a ship, or toward the stern.

ABOARD. Within, or upon, a ship.

ABREAST. Alongside of, or opposite to; as in the case of two or more ships lying with their sides parallel, and their heads equally advanced. With regard to objects within the ship, this term implies on a line parallel with the beam, or at right angles with the ship's length; as "the FENDERS should be placed abreast, or by the side of, the main hatchway."

ABSCISSE. *See* CONIC SECTIONS.

ACUTE ANGLE. *See* ANGLE. This sort of angle upon wood, &c. is by shipwrights denominated an under bevelling. *See* BEVELLING. *See also Circle, Fig. 2. Plate A.*

AFLOAT. Borne up by, or floating in, the water.

AFORE. The fore part of a ship, or toward the stem.

AFT. Towards, or near, the stern.

AFTER-BODY. That part of a ship's body abaft the midships or dead-flat. *(See* BODIES.) This term is more particularly used in expressing the *figure* or *shape* of that part of the ship. *See Body Plan, Plate* 1.

AFTER PART OF THE SHIP. All that part towards the stern, from the DEAD-FLAT, or broadest part of the ship. Or, with regard to the respective position of things placed in the direction of the ship's length, the term AFTER denotes that which is nearest to the stern.

AFTER TIMBERS. All those timbers abaft the MIDSHIPS OR DEAD FLAT.

AHEAD. Any thing, which is situated on that point of the compass to which a ship's stem is directed, is said to be ahead of her. Objects on board are said to be taken *ahead* when removed towards the stem.

AIR FUNNEL. A cavity framed between the sides of some timbers, to admit fresh air into the ship, and convey the foul air out of it. *See Disposition, Plate* 3.

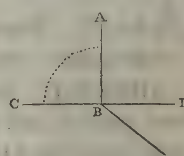
AMIDSHIPS. In midships, or in the middle of the ship, either with regard to her length or breadth. Hence that timber or frame which has the greatest breadth and capacity in the ship is denominated the *midship bend. See* DEAD-FLAT. *See also Sheer Draught, Plate* 1.

ANCHOR. The instrument of iron, &c. used, by means of a cable, to retain the ship in her station.

ANCHOR-LINING. The short pieces of plank, or of board, fastened to the sides of the ship, or to stantions under the fore channel, to prevent the bill of the anchor from wounding the ship's side, when fishing the anchor. *See Sheer Draught, Plate* 1.

To ANCHOR STOCK. To work planks in a manner resembling the stocks of anchors, by fashioning them in a tapering form from the middle, and working or fixing them over each other, so that the broad or middle part of one plank shall be immediately above or below the butts or ends of two others. This method, as it occasions a great consumption of wood, is only used where particular strength is required, as in the SPIRKETTINGS under ports, &c.

AN-END. The position of any mast, &c. when erected perpendicularly on the deck. The topmasts are said to be AN-END when they are hoisted up to their usual stations. This is also a common phrase for expressing the driving of any thing in the direction of its length, as to force one plank, &c. to meet the butt of another.



ANGLE. A corner or point where two lines or two planes meet; as the lines AB and CB.

An Angle is sometimes denoted by the single letter placed at the angular point, as B, or by three letters, of which that in the middle denotes the angle, as ABC. They are measured by the arch of a circle described from the centre with any radius, and are said to be greater or less according to the length of the arc contained between the legs or sides. If an angle contains exactly 90 degrees, (the one-fourth of the number of degrees in which every circle is supposed to be divided,) it is formed by one line perpendicular to another, and is called a RIGHT ANGLE, as ABC or ABD. If containing more than 90 degrees, it is said to be an OBTUSE-ANGLE, as CBE. If less than 90 degrees, an ACUTE-ANGLE, as DBE. An OBLIQUE-ANGLE is a common name for any angle that is not a right one, whether acute or obtuse. *See Circle, Plate A.*

ANGLE of DIRECTION. That angle which is comprehended between the lines of direction of two conspiring forces; as of wind and tide.

ANGLE of ELEVATION. That angle which is comprehended between a line of direction and any plane on which the projection is supposed to be made; as the angle formed by the direction of the bowsprit with the plane of the horizon.

Angle of Incidence. The angle made with the line of direction, by an impinging body, at the point of impact; as that formed by the direction of the wind upon the sails, or of the water upon the rudder, of a ship. *See* Impulsion. *See also Fig. 2. Plate A.*

Angle of Obliquity. *See* Impulsion.

APRON. A kind of false or inner stem, fayed on the aftside of the stem, from the head down to the dead-wood, in order to strengthen it. It is immediately above the foremost end of the keel, and conforms exactly to the shape of the stem, so that the convexity of one applied to the concavity of the other forms one solid piece, which adds strength to the stem, and more firmly connects it with the keel. *See Inboard Works, Plate* 4.

ARCH. Any part of the circumference of a circle. But, although in *Geometry* an arc is generally so considered, yet, in *Mechanics*, or building, this term is applied to any regular curve, whether circular or elliptical, either for support or for ornament. Thus the beams of a ship, that support the decks and expand the sides, are said to be *arched*, or curved upwards, in their greatest length, equal to the *round-up* given in the Tables of Dimensions. And, as the beams are arches of circles, which cannot, from the great length of their radii, be struck from a centre, here follows the most correct way of obtaining that arch or round-up to which the beam-mold must be made. *See Fig. 1. Plate A.*

First, strike the right line AB, equal to the length of the longest beam; then erect or square up the line C in the middle of the line AB, and on it set-off the *round-up* of the beam as given in the dimensions. Then strike the lines AD, BD. With the radius CD, from the centre D, describe a circle, and make the arch a e equal to the arch C a; and the arch b f equal to the arch C b. So the arches a e, and b f, will be equal, and, of consequence, the angles ADC, ADe, BDC and BDf, will all be equal.

Secondly, Divide the lines DC, De, and Df, into so many parts as shall be equal in number to the points of intersection required for the delineation of the required curve or arch. These parts may be either equal or unequal. It is only necessary that the divisions on the three lines, from the centre D, correspond with each other.

Thirdly, Strike the line Bk to the first division of the line Df, and a line from A through b, (the first division of the line DC,) to intersect the line B in P, which will be one point in the required curve. In like manner the other points are found, by striking lines from B to the several divisions of the line Df, and lines from A through the corresponding divisions of the line DC, to intersect those drawn from B, which will be in the circumference of the circle or arch. In the figure, as it is small, we have only drawn the lines Bk and AP, in order to prevent confusion in its appearance: but, in practice, we may take two chalked lines, and fasten one at A and the other at B, and stretching the one through the spots in the line DC, and the other through the corresponding spots in Df or De, the intersections of the chalked lines will give the several points or spots in the circumference, and a batten then pinned to those spots will form the ticked curve ADB, to which the round-up is to be made. In the same manner may the round-up and round-aft moulds of the Counter-Rails, &c. be made with more advantage than by any other method; because intersections may be obtained under the line AB, and the arch continued even to a circle, if required*.

Equal Arches are those which contain the same number of degrees, and whose radii are equal.

Similar Arches are those which contain the same number of degrees, but whose radii may be unequal. For example. If the arch BC (*Fig.* 2. *Plate A.*) contains the same number of degrees as the arch DE, or if the radius AB is to the radius AD as the arch BC is to the arch DE, then these arches are *similar*.

ARCH OF THE COVE. An elliptical moulding sprung over the cove at the lower part of the taffarel. *See Perpendicular View of the Stern in Plate* 1.

AREA. The superficial content of any figure, as of a parallelogram, six feet long and four feet broad, whose area will be 24 feet, because $6 \times 4 = 24$.

ASTERN. Any distance behind the ship, as opposed to ahead. Objects on board are said to be *astern* when near the stern of the ship.

ATHWART. At right angles with the ship's length, or across the line of her course.

AVAST! The command to stop or cease in any operation, as in bowsing or hawling.

AXIS. A real or supposed line through the centre of a body, about which it may turn: and hence the revolving figure may be imagined to produce a solid. Thus, if a semi-circle be supposed to move round its diameter at rest, it will generate a sphere, the *axis* of which is that diameter, and is commonly called the *Axis of Rotation.*

Axis is yet more generally used for a right line conceived to be drawn from the vertex of a figure to the middle of the base; as the axis of a cone. *See* Conic Sections.

In Mechanics, the axis of a balance is that line about which it moves or turns. The axis of oscillation is a right line, parallel to the horizon, passing through the centre, about which a pendulum vibrates.

AXIS in PERITROCHIO, or Wheel and Axle. One of the five mechanical powers, on the principle of which are constructed the windlasses and capstans of ships. *See* Mechanics.

BACK of the Post. The after-face of the Stern Post.

BACK-STAYS. The long ropes used to support the topmasts, &c. and second the efforts

* For the satisfaction of the geometrical reader, a Demonstration of this problem is here subjoined. As the angle formed at the centre of a circle is measured by the opposite arch, so the angle formed at the circumference is measured by *half* the opposite arch. Hence all angles that stand on a similar chord are equal; and, consequently, if there be ever so many equal angles standing on a similar chord, they will be all in the circumference of a circle; or, what is the same thing, a curve drawn through the several angular points will be an arch of a circle.

The triangles BDk and ADl are equal; for the sides AD and DB are equal, the sides Dk and Dl are likewise equal, and the angle BDk included by the sides BD and Dk is equal to the angle ADl included by the sides AD and Dl. Therefore the angle DBk is equal to the angle DAl.

The angles DAB and DBA are equal; and, as the three angles of every triangle contain 180 degrees, subtracting their sum from 180, we have the angle ADB. But the sum of the angles kBA and lBA is equal to the sum of the angles DAB and DBA, for the angle DBk is added to the angle DBA, and the angle DAl (equal to the angle DBk) is subtracted from the angle DAB, therefore the angle AbB is equal to the angle ADB, and, of consequence, the arch of the circle will pass through both: the like of all the rest.

of the shrouds when the mast is strained by a press of sail in a fresh wind. They reach from the topmast-heads to the starboard and larboard sides of the ship, where they are extended to the channels, or Backstay Stools. *See Steel's "Art of Rigging."*

BACKSTAY STOOL. A short piece of broad plank, bolted edge-ways to the ship's side, in the range of the channels, to project, and for the security of, the dead-eyes and chains for the Backstays. Sometimes the channels are left long enough to answer the purpose. *See Sheer Draught, Plate* 1.

BACK-SWEEP. *See* FRAMES.

BADGE. A sort of ornament fixed on the quarters of small vessels near the stern, containing either a sash for the convenience of the cabin, or the representation of it. It is commonly decorated with carved work, such as marine figures, martial instruments, &c. *See Yacht, Plate* 11.

BALCONY. The gallery in the stern of large ships. *See Sheer Draught, and Perpendicular View of the Stern, Plate* 1.

BALANCE FRAMES. Those *frames*, or bends of timber, of the same capacity or area, which are equally distant from the centre of gravity. *See* FRAMES.

BALLAST. A quantity of iron, stone, or gravel, or such like materials, deposited in a ship's hold, when she has no cargo, or too little to bring her sufficiently low in the water. It is used to counterbalance the effort of the wind upon the sails, and give the ship a proper stability, that she may be enabled to carry sail, without danger of over-setting.

BALLUSTERS. The ornamental pillars placed round the balcony in the stern and quarters in large ships.

BARK. A name given to small ships; especially to square-sterned ships having no head-rails, and to such as have three masts without a mizen top sail.

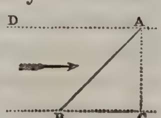
BARREL. The main piece of a capstan or steering wheel. *See* CAPSTAN and STEERING-WHEEL. *See also Capstan, Plate* 7.

BARGE. *See* BOATS.

BARS of the CAPSTANS and PORTS. *See* those Articles.

BASE. The foot or lowest part of a pillar; or that part of a body on which it rests, or is designed to rest. In geometry, an horizontal line upon which any figure is to be raised.

The base of any surface as exposed to a stream of fluid is that portion of a plane, perpendicular to the stream, which is covered or protected from the action of the stream by the surface exposed to its impulse. Thus the base of a sphere exposed to a stream of fluid is its great circle, whose plane is perpendicular to the stream. Hence, if the plane surface AB was exposed to the action of a stream moving in the direction DA, then AC, perpendicular to BC, is its base.



BATTENS. In general, light scantlings of wood. In ship-building, long narrow laths of fir, their ends corresponding and fitted into each other with mortice and tenon, used in setting fair the sheer-lines on a ship. They are painted black in order to be the more conspicuous. Battens used on the mold-loft floor, are narrow laths, of which some are accurately graduated and marked with feet, inches, and quarters, for setting off distances. Battens for gratings are narrow thin laths of Oak. *See* GRATINGS.

BEAK-HEAD. The short platform at the fore part of the upper deck, in large ships, placed at the height of the ports from the deck, for the convenience of the chace-guns. Its termination aft is the bulk-head called the *beak-head bulk-head,* which incloses the fore-part of the ship. *See Sheer Draught, Plate* 1.

BEAK-HEAD-BEAM. The same as Cat-Beams, which see.

BEAMS. The substantial pieces of timber which stretch across the ship, from side to side, to support the decks and keep the ship together by means of the *Knees*, &c. their ends being lodged on the clamps, keeping the ship to her breadth. *See Plans of the Decks, Plates* 5 *and* 6.

Beam-Arm, or Fork-Beam, is a curved piece of timber, nearly of the depth of the beam, scarphed, tabled, and bolted, for additional security to the sides of beams athwart large openings in the decks, as the main hatchway and the mast-rooms. *See Plans of the Decks, Plates* 5 *and* 6.

Breast-Beams. Are those beams at the fore-part of the quarter deck and round house, and after part of the forecastle. They are sided larger than the rest; as they have an ornamental rail in the front, formed from the solid, and a rabbet one inch broader than its depth, which must be sufficient to bury the deals of the deck, and one inch above for a spurn-water. To prevent splitting the beam in the rabbet, the nails of the deck should be crossed, or so placed, alternately, as to form a sort of zigzag line. *See Inboard Works, Plate* 4, *and Plans, Plate* 6.

Cat-Beam, or Beak-Head Beam. This is the broadest beam in the ship, generally made in two breadths, tabled and bolted together. The foreside is placed far enough forward to receive the heads of the stantions of the beak-head bulk-head. *See Inboard Works, Plate* 4, *and Plans, Plate* 6.

The Collar-Beam is the beam upon which the stantions of the beak-head bulk-head stand. The upper side of it is kept well with the upper side of the upper deck port-sills, and lets down upon the spirketting at the side. But its casting over the bowsprit in the middle giving it a form which in timber is not to be gotten without difficulty, a framing of two large carlings and a stantion on each side of the bowsprit is now generally substituted in its place. *See Inboard Works, Plate* 4.

Half-Beams are short beams introduced to support the deck where there is no framing, as in those places where the beams are kept asunder by hatchways, ladder ways, &c. They are let down on the clamp at the side, and near midships into fore and aft carlings. On some decks they are, abaft the mizen-mast, generally of fir, let into the side tier of carlings. *See Plan of Upper Deck, Plate* 6.

The Midship Beam is the longest beam of the ship, lodged in the midship-frame, or between the widest frame of timbers.

Palleting-Beams, are those beams under the flat of the Magazine, Bread Room, and Powder Room, where there is a double *palleting*. The upper tier are of fir, and rabbets are taken out of their edge to form scuttles. *See Inboard Works, Plate* 4, *and Orlop Plan, Plate* 5.

BEARDING. The diminishing of the edge or surface of a piece of timber, &c. from a given line, as on the deadwood, clumps, plank-sheers, fife-rails, &c. *See Sheer Draught, Plate* 1

BEARDING-LINE. A curved line occasioned by bearding the dead wood to the form of the body; the former being sided sufficiently, this line is carried high enough to prevent the heels of timbers from running to a sharp edge, and forms a rabbet for the timbers to step on; hence it is often called the STEPPING LINE. *See Sheer Draught, Plate* 1.

BED. A solid framing of timber to receive and to support the mortar in a Bomb Vessel.

BED or BARREL SCREWS. *See* SCREWS.

BEETLE. A large mallet used by Caulkers for driving in their reeming irons to open the seams, in order for caulking.

BELLFRY. An ornamental framing, made of stantions, at the after beams of the forecastle, with a covering or top, under which the ship's bell is hung. In large ships the stantions are supported by knees. In small ships it is sometimes built over the windlass. *See Inboard Works, Plate* 4.

BELLY. The inside or hollow part of compass or curved timber, the outside of which is called the BACK.

BELL-TOP. A term applied to the top of a quarter gallery when the upper stool is hollowed away, or made like a rim, to give more height as in the quarter galleries of small vessels, and the stool of the upper finishing comes home to the side, to complete overhead. *See the Draught of the Sloop, Plate* 10.

BENCHES OF BOATS. The seats in the after part whereon the passengers sit.

BEND-MOULD, in whole moulding. (*See* WHOLE MOULDING.) A mould made to form the futtocks in the square body, assisted by the rising-square, and floor-hollow. *See Moulds, Plate* 1 *of Laying off.*

BENDS. The frames or ribs that form the ship's body from the keel to the top of the side at any particular station. They are first put together on the ground. That at the broadest part of the ship is denominated the MIDSHIP-BEND or DEAD FLAT. *See Midship Sections, Plate* 8.

In North Britain, the fore part of the Wales are commonly called *Bends*.

BETWEEN-DECKS. The space contained between any two decks of a ship.

BEVEL. A well known instrument, composed of a stock and a moveable tongue, for taking of angles on wood, &c. by shipwrights called BEVELLINGS.

BEVELLING BOARD. A piece of deal on which the bevellings or angles of the timbers &c. are described.

BEVELLINGS. The windings or angles of the timbers, &c. a term applied to any deviation from a square or right-angle. Of Bevellings there are two sorts, denominated *Standing Bevellings* and *Under Bevellings*. By the former is meant an obtuse angle or that which is *without a square;* and, by the latter, is understood an acute angle or that which is *within a square. See Circle, Plate A.*

BILGE. That part of a ship's floor, on either side of the keel, which has more of an horizontal than of a perpendicular direction, and on which the ship would rest if laid on the ground: or, more particularly, those projecting parts of the bottom which are opposite to the heads of the floor-timbers amidships, on each side of the keel.

BILGE TREES, or Bilge Pieces, or Bilge Keels. The pieces of timber, fastened under the bilge of boats or other vessels, to keep them upright when on shore, or to prevent their falling to leeward when sailing. *See Plate containing the Life Boat, and Midship Sections, Plate* 8.

BILGEWAYS. A square bed of timber, placed under the bilge of the ship, to support her while launching. *See Frigate and Launch, Plate* 9.

BILL of the Anchor. The extremity of the arm.

BILLS. The ends of Compass or Knee Timber.

BINACLE. (Formerly Bitacle.) A wooden case or chest which contains the compasses and lights to shew them by night, &c. It is divided into three apartments with sliding shutters. Those at the side have a compass in each, and that in the middle is fitted to hold a lamp or candles, which emit light on the compasses through a pane of glass in each side. In small vessels it is sometimes fixed before the Companion, and the lights put in from the Captain's ladderway without going upon deck. On the deck of a ship of war there are always two Binacles, one for the use of the man who steers, and the other for him who *cons*, or superintends the steerage.

BINDINGS. The iron links which surround the *Dead Eyes. See Sheer Draught, Plate* 1, *and Midship Sections, Plate* 8.

BINDING STRAKES. Two strakes of oak plank, worked all fore and aft upon the beams of each deck, within one strake of the coamings of the main hatchway, in order to strengthen the deck, as that strake and the midship strakes are cut off by the pumps, &c. *See Plans, Plates 5 and* 6.

BINS. A sort of large chests, or erections in store-rooms, in which the stores are deposited. They are generally 3 or 4 feet deep, and nearly of the same breadth.

To BIRTH-UP. A term generally used for working up a topside or bulk-head with board or thin plank.

To BISECT. To divide a line, angle, &c. into two equal parts.

BITTS. A frame of oak timber, whereon the cables or ropes are occasionally fastened. It consists of two upright pieces of oak, called *Bitt Pins*, when the Bitts are large, or of knees, when the Bitts are small, with a cross piece fastened horizontally near the head of them. The largest Bitts are commonly called the Riding Bitts, and are those to which the cables are fastened when the ship rides at anchor. There are also small Bitts to belay ropes to, as the Bowline and Brace Bitts, situated near the masts; the Fore Jear and Topsail Sheet Bitts situated on the forecastle and round the foremast; the Mainjear and Topsail Sheet Bitts which tenon into the foremost beam of the quarter deck. The Bitts round the mizen mast are generally formed of knees, with sheave-holes for the topsail sheets, &c. *See Inboard Works, Plate* 4, *and Plans, Plates 5 and* 6.

BITT-PINS. The upright pieces of oak timber, let in and bolted to the beams of two decks, at least, and to which the piece of the Bitts is fastened. *See Inboard Works, Plate* 4.

BLACK-STRAKE. A broad strake, which is parallel to, and worked upon the upper edge of, the Wales, in order to strengthen the ship. It derives its name from being paid with pitch, and is the boundary for the painting of the topsides. Ships having no ports near the Wales, have generally two black-strakes. *See Planking, Plate 3, and Midship Sections, Plate* 8.

BLOCK. The large piece of elm out of which the figure is carved at the head of the ship. *See Sheer Draught, Plate* 1.

BLOCKS for building the ship upon, are those solid pieces of oak timber fixed under the ship's keel, upon the groundways.

BLOCKS, FIXED, are solid pieces of oak, let through the sides of the ship, and fitted with sheaves to lead the tacks, sheets, braces, &c. into the ship. *See Disposition of the Frame, Plate* 2.

BLOCKS to LEAD in the CATFALL are fixed on the plank-sheer over the Catheads. A sheave hole is cut in each that the fall may lead in fair upon deck. *See Sheer Draught, Plate* 1.

BLOCKS for the FORE and MAIN LIFTS, DERRICK, and MIZEN JEARS, are kevel-headed blocks, bolted vertically to the sides, abreast the main, fore, and mizen, masts; those for the fore-mast within side, and the others on the outside, of the ship.

BLOCKS for TRANSPORTING the ship, are two solid pieces of oak or elm, one fixed on each side of the stern above the taffarel, and a snatch with a large score cut each way in the middle. When used, the Hawser is hauled in through the Snatch. *See Sloop of War, Plate* 10.

BOARD. Timber sawed to a less thickness than plank; all broad stuff of or under one inch and a half in thickness.

BOATS. Small vessels which, excepting rowing boats, are generally decked over. Boats are managed on the water by rowing or sailing, and are occasionally slight or strong, sharp or flat bottomed, open or decked, plain or ornamented, as they may be designed either for celerity or burthen, for deep or shallow water, for sailing in a harbour or at sea, for convenience or pleasure.

The construction and the names of boats are very different, according to the various purposes for which they are calculated, and the services required of them. The largest that ships take to sea is the LONG BOAT, (*Plate* 23,) built very strongly, and furnished with masts and sails. The LAUNCH is a sort of Long-Boat, but not built upon a principle of sailing, it being more flat, is broader, and more useful for weighing small anchors than the Long-Boat. The BARGE is next in size, but very different from the former in its construction, having a slighter frame, and being more ornamented. It is constructed for rowing, having conveniences for ten or twelve oars, and is chiefly employed for the conveyance of Admirals and other officers of rank to and from the ship. The PINNACE is of the same form as the Barge, but is something smaller, and never row more than eight oars. It is for smaller ships, or for the use of officers of subordinate rank. CUTTERS for ships are for the conveyance of seamen, or the lighter stores. They are shorter and broader in proportion to their length than the Long Boat, are clincher built, and constructed for sailing. A Yawl is something less than the Pinnace, nearly of the same form, and used for similar purposes. They are generally rowed with six oars.

BOATSWAIN'S STORE ROOM. *See* STORE-ROOMS.

BOBSTAY. The large rope or stay used to confine the Bowsprit upon the stem, and counteract the force of the stays which draw it upwards.

BOBSTAY HOLES. Holes cut through the fore part of the knee of the Head, below the cheeks, large enough to admit the Bobstay-Collars, to which the Bobstays are set up for the security of the Bowsprit. They should come through the knee between the two upper bolts. Sometimes they are farther secured by iron straps between the holes extended on the knee to bolt in the main piece. *See Sloop, Plate* 10.

BODIES. The figure of a ship, abstractedly considered, is supposed to be divided into different parts, or figures, to each of which is given the appellation of *Body*. Hence we have the terms Fore Body, After Body, Cant Bodies, and Square Body. Thus the *Fore Body* is the figure, or imaginary figure, of that part of the ship afore the midships or dead-flat, as seen from ahead. The *After Body*, in like manner, is the figure of that part of the ship abaft the midships, or dead flat, as seen from astern. The *Cant Bodies* are distinguished into *Fore* and *After*, and signify the figure of that part of a ship's body or timbers, as seen from either side, which form the shape forward and aft, and whose planes make obtuse angles with the midship line of the ship; those in the Fore Cant Body being inclined to the stem, as those in the After one are to the stern post. The *Square Body* comprehends all the timbers whose areas or planes are perpendicular to the keel and square with the middle line of the ship; which is all that portion of a ship between the Cant Bodies. *See the Plates of Laying-Off.*

BOLLARD TIMBERS or KNIGHT-HEADS. *See* Knight-Heads.

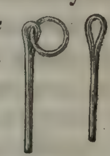
BOLSTERS. Pieces of oak timber fayed to the curvature of the bow, under the Hawse-Holes and down upon the upper or lower cheek, to prevent the cable from rubbing against the cheek. *See Sloop, Plate* 10.

Bolsters for the Anchor Lining, are solid pieces of oak, bolted to the ship's side, at the fore part of the fore chains, on which the stantions are fixed that receive the anchor lining. The fore end of the bolster should extend two feet or more before the lining, for the convenience of a man's standing to assist in fishing the anchor. *See Sheer Draught, Plate* 1.

Bolsters for Sheets, Tacks, &c. are small pieces of fir or oak fayed under the Gunwale, &c. with the outer surface rounded to prevent the sheets and other rigging from chafing.

BOLTS. Cylindrical or square pins of iron or copper, of various forms, for fastening and securing the different parts of the ship, the guns, &c. The figure of those for fastening the timbers, planks, hooks, knees, crutches, and other articles of a similar nature, is cylindrical, and their sizes are adapted to the respective objects which they are intended to secure. They have round or saucer heads, according to the purposes for which they may be intended; and the points are fore-locked or clinched on rings to prevent their drawing. Those for bolting the frames or beams together are generally square.

Ring and Eye Bolts for securing the guns, &c. have the part that enters into the wood cylindrical. Those for ring-bolts have the rings turned into an eye made at the head of the bolt. The rings are sometimes made angular to receive many turns of lashing; such are the bolts for lashing the booms and spare anchors. *Eye Bolts* have only an eye made at the head of the bolt, to which the tackles, &c. may be hooked. *See Midship Sections, Plate* 8. Some eye-bolts have a shoulder to them, to resist a great strain, as the Fish-tackle eye bolt, which has a plate or long strap made under the eye to pre-



vent its burying in the plank. The TOGGLE-BOLT * has a flat head and a mortise through it, that receives a toggle or pin. Its use is to confine the ensign staff, &c. into its place, by means of a strap.

A WRAIN BOLT is a ring-bolt, with two or more forelock holes in it, occasionally to belay or make fast towards the point. It is used, with the Wrain Staff in the ring, for setting-to the planks.

BOMB-VESSEL. A vessel of war, more particularly described hereafter, and particularly designed for throwing shells from mortars. It was invented by the French, and said to have been first used in the bombardment of Algiers. Prior to that time the throwing of shells from sea was supposed impossible.

BOMB-BED BEAMS. The beams which support the Bomb-Bed in Bomb-Vessels.

BOOM-KINS. *See* BUMKINS.

BOTTOM. All that part of a ship or vessel that is below the Wales. Hence we use the epithet *sharp-bottomed* for vessels intended for quick-sailing, and *full-bottomed* for such as are designed to carry large cargoes.

BOW. The circular part of the ship forward, terminated at the rabbet of the stem.

To BOWSE. To pull upon any body with a tackle, &c. in order to remove it.

BOWSPRIT. The boom or mast projecting over the stem. *See Sheer Draught, Plate* 1.

BOXING. A projection of wood formerly left on the Hawse-pieces, in the wake of the hawse holes, and which projected as far out as the plank inside and out. This method of fitting the hawse holes is now, however, generally laid aside, as among other advantages which attend the present practice, it is found that, as the method of boxing consumed an unnecessary quantity of large timber, this expence is now avoided; besides which, the planks, without boxing, run forward to the stem, and thereby strengthen the bow. The purpose of boxing is much better answered by a pipe of lead let through the holes, and turned with a flap inside and out, the undersides of which are thickest, to allow for the wearing of the cable.

The term BOXING is also applied to the scarph of the lower piece of the stem, let flatwise into the fore-foot. *See Sheer Draught, Plate* 1.

BRACES. Straps of iron, copper, or mixt metal, secured with bolts and screws to the stern post and bottom planks. In their after ends are holes to receive the pintles by which the rudder is hung. *See* PINTLES. *See also Sheer Draught, Plate* 1.

BRACES formerly called POINTERS are, also, square pieces of timber fixed diagonally across the hold to support the bilge and prevent the ship's working. *See Midship Sections, Plate* 8.

BRACKETS. Short crooked timbers, resembling knees, for support or ornament. The HAIR BRACKET is the boundary of the aft part of the figure head, and its lower part finishes with the fore part of the upper cheek. (*See Sheer Draught, Plate* 1.) The CONSOLE BRACKET is a light piece of ornament at the fore part of the quarter gallery, sometimes called a CANTING-LIVRE. *See Sloop of War, Plate* 10.

* The figure of this and other bolts may be seen in Steel's "Art of Mastmaking."

Stern Brackets are carved ornaments on the munions, under the taffarel, at the arch of the coves, &c.

BRAKES. The handles or levers by which the pumps are worked.

BREAD ROOM. A place parted off below the lower deck, close abaft, for the reception of the Bread. *See* Store-Rooms.

BREADTH. A term more particularly applied to some essential dimensions of the extent of a ship or vessel athwartships, as the Breadth-Extreme, and the Breadth-Moulded, which are two of the principal dimensions given in the building of the ship. The *Extreme Breadth* is the extent of the midships or dead-flat with the thickness of the bottom plank included. The *Breadth-Moulded*, is the same extent without the thickness of the plank.

BREADTH-LINE. A curved line of the ship lengthwise, intersecting the timbers at their respective broadest parts. *See Sheer Draught, Plate* 1.

BREADTH-SWEEP. A term applied to the radius of the arch which forms part of the shape of a ship's body at the *Breadth-Line*. When the body is formed by two circular arches, one of them is called the *Lower Breadth Sweep*, and the other, which forms the body above the Breadth Line, is called the *Upper Breadth Sweep*. *See* Frames. *See also Body Plan and Sheer Draught, Plate* 1.

BREAK. The sudden termination or rise in the decks of some merchant ships, where the aft and sometimes the fore part of the deck is kept up to give more height between decks, as likewise at the Drifts.

BREAST-HOOKS. Large pieces of compass timber fixed within and athwart the bows of the ship, of which they are the principal security, and through which they are well bolted. There is generally one between each deck, and three or four below the lower deck, fayed upon the plank. Those below are placed square to the shape of the ship at their respective places. The Breast-Hooks that receive the ends of the deck-planks are also called Deck-Hooks, and are fayed close home to the timbers in the direction of the decks. *See Inboard Works, Plate* 4, *and Plans, Plates* 5 *and* 6.

BREAST-RAIL. The upper rail of the balcony; or of the breast work at the fore part of the quarter deck. *See Sheer Draught, and perpendicular View of the Stern, Plate* 1, *Inboard Works, Plate* 4, *and Plans, Plate* 6.

BREAST-WORK. The stantions, with their rails, at the fore part of the quarter-deck. The Breast-work fitted on the upper deck of such ships as have no quarter-deck serves to make a separation from the main-deck. *See Inboard Works, Plate* 4, *and Plans, Plate* 6.

BREECH. The angular part of knee-timber.

BRIG or BRIGANTINE. A merchant vessel having two masts, with the mainsail fore and aft, and not athwartships as in ships.

In the Royal Navy, when cutter-built vessels are thus rigged, they are called Cutter-Brigs.

BROKEN-BACKED or HOGGED. The condition of a ship when the sheer has departed from that regular and pleasing curve with which it was originally built. This is often occasioned by the improper situation of the centre of gravity, when so posited as not to counterbalance the effort of the water in sustaining the ship, or, by a great strain, or, from the weakness of construction. The latter is the most common circumstance, particularly in some French ships, owing partly to their great length, sharpness of floor, or general want of strength in the junction of the component parts.

BUCKLERS. Pieces of elm plank, barred close against the inside of the Hawse Holes, to prevent the water from coming in. Those used at sea, denominated BLIND BUCKLERS, have no aperture; but those used in a harbour, &c. when a ship is at anchor, and called RIDING-BUCKLERS, are made in two pieces, the upper piece rabbeting on the lower piece at the middle of the Hawse-Hole, and the two pieces, when joining, have a hole in the middle large enough to admit the cable.

BULGE, or BILGE. That part of the ship which she bears on most when not afloat. It may be readily known by drawing a line from the underside of the keel to touch the body. *See* BILGE.

BULGEWAYS. *See* BILGEWAYS.

BULKHEADS. The various partitions which separate one part of a ship from another. Those in the Hold are mostly built with rabbetted or cyphered plank, as are those of the Magazine, to keep the powder securely from the cargo, ballast, or stowage in the Hold; and, in ships of the Royal Navy the next bulkhead aft keeps the Spirits from the Hold; thus likewise of the Fish and Bread-room bulkheads. Those upon the decks are mostly to separate the officers from the seamen, as the ward-room bulkhead, which is composed of doors and panels of joiner's work; thus, also, the Cabin and Screen Bulkheads; the latter, in large ships, incloses the Cabin from the walk abaft, or Balcony: and, forward, the Galley is inclosed by the beak-head bulkhead. *See Inboard Works, Plate* 4.

BUM-KIN, or more properly BOOM-KIN. A projecting piece of oak or fir, on each bow of a ship, fayed down upon the False Rail, or Rail of the Head, with its heel cleated against the Knight-head in large, and the Bow in small, ships. It is secured outwards by an iron rod or rope lashing, which confines it downward to the knee or bow, and is used for the purpose of hauling down the fore-tack of the foresail. *See Plan of the Head on the Half-breadth Plan, Plate* 1.

BURTHEN. The weight or measure that any ship will carry or contain when fit for sea.

BUSHED. Cased with harder metal; as that inserted into the holes of braces or sheaves to prevent their wearing, and, consequently, to take off friction.

BUTT. The joints of the planks endwise, also the opening between the ends of the planks when worked for caulking. Where caulking is not used, the butts are rabbetted, and must fay close. *See Planking, Plate* 3, *and Plans, Plates* 5 *and* 6. BUTT also signifies the root or biggest end of all timbers, plank, &c.

BUTTOCK. That rounding part of the body abaft bounded by the fashion-pieces; and, at the upper part, by the wing transom.

BUTTOCK LINES. (On the Sheer Draught.) Curves, lengthwise, representing the ship as cut in vertical sections. *See Sheer Draught, Plate* 1.

CÆTERIS PARIBUS. A Latin term used by mathematical writers, signifying literally, the rest or all other things being alike or equal.

CABINS. The apartments partitioned off in several parts of the ship, for the residence of the officers, of which the principal is for the commander. *See Plans, Plates 5 and* 6.

CABLE. A rope, more than nine inches in circumference, and generally one hundred fathoms in length, used to retain the ship at anchor.

CABLE TIER. The space occupied by the cables on the Orlop Deck. *See Orlop Plan, Plate 5.*

CALLIPERS. Compasses with circular legs, for taking correctly the diameter or size of timber. There is a smaller sort for taking the diameter of bolts or any thing cylindrical.

CAMBER. Hollow or arching upwards. The decks are said to be *cambered* when their height increase toward the middle, from stem and stern, in the direction of the ship's length.

CAMEL. A machine for lifting ships over a bank or shoal, originally invented by the celebrated De Witt, for the purpose of conveying large vessels from Amsterdam over the Pampus. They were introduced into Russia by Peter the Great, who obtained the model when he worked in Holland, as a common shipwright, and are now used at Petersburgh for lifting ships of war built there over the bar of the harbour. A Camel is composed of two separate parts, whose outsides are perpendicular, and insides concave, shaped so as to embrace the hull of a ship on both sides. Each part has a small cabin, with sixteen pumps and ten plugs, and contains twenty men. They are braced to the under part of the ship by means of cables, and entirely inclose its sides and bottom. Being then towed to the bar, the plugs are opened, and the water admitted until the Camel sinks with the ship, and runs aground. Then, the water being pumped out, the Camel rises, lifts up the vessel, and the whole is towed over the bar. This machine can raise the ship eleven feet, or in other words, make it draw eleven feet less water.

CANT. A term signifying the inclination that any thing has from a square or perpendicular. Hence the shipwrights say,

Cant Body, meaning that part of a ship's body or timbers which form the shape of the body forward and aft, and whose planes make obtuse angles with the midship line of the ship; those in the forebody inclining to the stem, as those in the afterbody incline to the stern-post. *See* Bodies. *See also Sheer Draught, Plate* 1.

Cant-Ribbands, are those ribbands that do not lie in a horizontal or level direction, or square from the middle line, but nearly square from the timbers, as the diagonal ribbands. *See* Ribbands. *See also Laying-off, Plate* 8.

Cant-Timbers, are those timbers afore and abaft, whose planes are not square with, or perpendicular to, the middle line of the ship. *See Laying-off, Plates* 3 *and* 4.

CANTING. The act of turning any thing completely over, so that the under surface shall lie upwards. It is otherwise said to be *half* or *quarter canted.*

CANTING LIVRE. The same as *Console Bracket. See* Brackets.

CAPS. Square pieces of oak, laid upon the upper blocks on which the ship is built, to receive the keel. They should be of the most freely grained oak, that they may be easily split out when the false keel is to be placed beneath. The depth of them may be a few inches more than the thickness of the false keel, that it may be set up close to the main keel by slices, &c.

A CAP SCUTTLE. A framing composed of coamings and head ledges, raised above the deck, with a flap or top which shuts closely over into a rabbet. *See Inboard Works, Plate* 4.

CAPSTAN. The machine, formed of a massy column of timber, &c. and used for heaving up the anchor or other purposes which require an extraordinary effort. It is composed, as described hereafter, of several pieces, strongly united into one body, called the *barrel*, and put in motion by the levers, named Capstan bars, which fit into mortise holes in its head. *See Capstan, Plate* 7.

CAPTAIN's STORE ROOM. *See* STORE-ROOMS.

CARLINGS. Long pieces of timber, above four inches square, which lie fore and aft, in tiers, from beam to beam, into which their ends are scored. They receive the ends of the ledges for framing the decks. The Carlings by the side of, and for the support of, the mast, which receive the framing round the mast called the partners, are much larger than the rest, and are named the MAST CARLINGS. Besides these there are others, as the PUMP CARLINGS, which go next without the Mast Carlings, and between which the pumps pass into the well; (*See Plans, Plate 5 and* 6.) and also the Fire-Hearth Carlings, that let up under the beam on which the fire-hearth stands, with pillars underneath, and chocks upon it, fayed up to the ledges for support. *See Inboard Works, Plate* 4.

CARPENTERS' STORE ROOM. *See* STORE ROOMS.

CARRICK BITTS. The upright pieces of timber near the ends of the Windlass, in which are the Gudgeons for the spindles to work on. *See Windlass, Plate* 7.

CARVEL WORK. A term applied to Cutters and Boats, signifying that the seams of the bottom-planking are square, and to be kept tight by caulking as those of ships. It is opposed to the phrase CLINCHER-BUILT, which see.

To CAST. To stretch over any thing, as

CAST-KNEES, or those Hanging-Knees which crook or arch over the corner of a gun-port, rider, &c.

CAT-BEAM. *See* BEAM.

CAT BLOCK. *See* BLOCKS.

CAT-HEADS. The two strong arms of oak projecting from each side of the ship, at the fore part of the forecastle, with sheaves in their outer ends for the purpose of hoisting the anchor. *See Sheer Draught, Plate* 1, *and Plans, Plate* 6.

CAVITY. The hollow formed in the water by an immersed body. *See* CENTRE of CAVITY.

CAULKING. Forcing oakum into the seams and between the butts of the plank, &c. with iron instruments, in order to prevent the water penetrating into the ship.

CEILING or FOOTWALING. The inside planks of the bottom of the ship.

CENTRE. A point equally distant from the extremities of a body or figure.

CENTRE of CAVITY, or of DISPLACEMENT. The centre of that part of the ship's body which is immersed in the water; and which is also the centre of the vertical force that the water exerts to support the vessel. *See Sheer Draught, Plate* 1.

CENTRE of GRAVITY. That point about which all the parts of a body do, in any situation, exactly balance each other. Hence, 1. If a body be suspended by this point as the centre of motion, it will remain at rest in any position indifferently. 2. If a body be suspended in any other point, it can rest only in two positions, viz. when the centre of gravity is exactly above or below the point of suspension. 3. When the centre of gravity is supported, the whole body is kept from falling. 4. Because this point has a constant endeavour to descend to the centre of the earth, therefore—5. When the point is at liberty to descend, the whole body must also descend, either by sliding, rolling, or tumbling over. *See* Gravity.

CENTRE of MOTION. That point of a body which remains at rest whilst all the other parts are in motion about it; and this is the same, in bodies of one uniform density throughout, as the centre of gravity.

CENTRE of OSCILLATION. That point in the axis or line of suspension of a vibrating body, or system of bodies, in which if the whole matter or weight be collected, the vibrations will still be performed in the same time, and with the same angular velocity, as before.

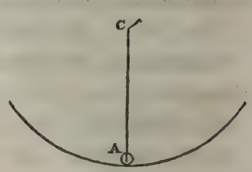
CENTRE of PERCUSSION, in a moving body, is that point where the percussion or stroke is the greatest, and in which the whole percutient force of the body is supposed to be collected. Percussion is the impression a body makes in falling or striking upon another, or the shock of bodies in motion striking against each other. It is either direct or oblique; *direct* when the impulse is given in a line perpendicular to the point of contact; and *oblique* when it is given in a line oblique to the point of contact.

CENTRE of RESISTANCE to a fluid. That point in a plane to which, if a contrary force be applied, it shall just sustain the resistance.

CENTRE of ROTATION. This term is synonimous with *axis of rotation* when confined to one point as a centre. *See* Axis.

CENTRAL FORCES. The powers which cause a moving body to tend towards, or recede from, the centre of motion.

Thus, if a body A be suspended at the end of a string AC, as a centre, and in that position it receives an impulse in a horizontal direction, it will be thereby compelled to describe a circle about the central point. While the circular motion continues, the body will certainly endeavour to recede from the centre, and the force arising from the horizontal impetus is called its *centrifugal force.*



With the centrifugal force it acts upon the fixed centre pin, and that, by its immobility, re-acts with an equal force on the body, by means of the string, directed towards itself, the centre of motion; whence it is called the *centripetal force*: and, when we speak of either or both of these powers indefinitely, we call them the *central forces* of the revolving body.

CENTRIFUGAL FORCE. That force by which all bodies that move round any other body in a curve endeavour to fly off from the axis of their motion.

CENTRIPETAL FORCE. That force by which a body is every where impelled or any how tends towards some point as a centre. Such is gravity, or that force whereby bodies tend towards the centre of the earth; and such also is that force, whatever it be, which retain the planets in their course.

CHAIN or CHAINS. The links of iron which are connected to the binding that surround the dead-eyes of the channels. They are secured to the ship's side by a bolt through the toe-link called a *chain-bolt.* *See Sheer Draught, Plate* 1, *and Midship Sections, Plate* 8.

CHAIN-BOLT. A large bolt to secure the chains of the dead-eyes, for the purpose of securing the mast by the shrouds. *See Sheer Draught, Plate* 1. *and Midship Sections, Plate* 8.

CHAIN-PLATES. Thick iron plates, sometimes used in merchant ships, which are bolted to the ship's sides, instead of chains to the dead-eyes, as above. *See Hoy, Plate* 23.

CHAMFERING. Taking off the sharp edge from timber or plank, or cutting the edge or end of any thing bevel or aslope.

CHANNELS. The broad projection or assemblage of planks, fayed and bolted to the ship's sides, for the purpose of spreading the shrouds with a greater angle to the dead-eyes. They should therefore be placed either above or below the upper deck ports, as may be most convenient. But it is to be observed that, if placed too high, they strain the sides too much; and if placed too low, the shrouds cannot be made to clear the ports without difficulty. Their disposition will therefore depend on that particular which will produce the greatest advantage. They should fay to the sides only where the bolts come through, having an open space of about two inches in the rest of their length, to admit a free current of air, and a passage for wet and dirt, in order to prevent the sides from rotting. *See Sheer Draught, Plate* 1. *and Midship Sections, Plate* 8.

CHANNEL WALES. Three or four thick strakes, worked between the upper and lower deck ports in two decked ships, and between the upper and middle deck ports in three decked ships, for the purpose of strengthening the topside. They should be placed in the best manner for receiving the chain and preventer bolts, the fastenings of the deck-knees, &c. *See Sheer Draught, Plate* 1. *and Midship Sections, Plate* 8.

CHASE. A score cut lengthwise for a tenon to be fixed in, as the tenon at the heels of pillars, &c. chased about, as "Chased about into the carlings."

CHASE-PORTS. The ports at the bows, or through the stern of the ship. The former are made for the purpose of firing at an enemy a-head, and are called bow-chasers. The latter for the purpose of firing upon an enemy in pursuit, or for dismasting an enemy that may lie athwart the stern in order to rake the ship. *See Plans, Plates* 5 *and* 6.

CHEEKS. Knees of oak-timber which support the knee of the head, and which they also ornament by their shape and mouldings. They form the basis of the head, and connect the whole to the bows, through which and the knee they are bolted. *See Sheer Draught and Plan of the Head, Plate* 1.

CHEEKS are also the circular pieces on the aftside of the Carrick Bitts. *See Windlass, Plate* 7.

CHESTREES. Pieces of oak timber fayed and bolted to the topsides, one on each side, abaft the fore-channels, with a sheave fitted in the upper part for the convenience of hauling home the main tack *See Sheer Draught, Plate* 1.

CHINE. That part of the waterways, which is left the thickest, and above the deck-plank. It is bearded back that the lower seam of spirketting may be more conveniently caulked, and is gouged hollow in front to form a watercourse. *See Midship Sections, Plate* 8.

To CHINSE. To caulk slightly with a knife or chisel, those seams or openings that will not bear the force required for caulking in a more proper manner.

CHISELS. Edged tools, too well known to require a particular description, and used in cutting away wood, &c.

Cold Chisels are short stout chisels made of steel, for cutting iron bolts, &c.

CHOCKS. Smaller pieces of wood used to make good some deficiency in the main piece, as those at the heads and heels of timbers, the frame-knees, &c. *See Plans, Plates 5 and 6, and Midship Sections, Plate 8.*

Cross Chocks are larger pieces of oak timber fayed across the dead-wood and heels of the first futtocks, to make them equal in height with the floors. In merchant ships they are seldom used. Elm for this purpose may be used with the same advantage as oak, as along the midships it will be equally durable and is less liable to split. *See Midship Sections, Plate 8.*

Chocks, or Rowlock Chocks of Boats, are a sort of cleat, fastened on the gunwale to support the tholes. *See* Pinnace, *Plate 25.*

CHORD LINE. A right line drawn from one end of a circular arch to the other. *See Circle, Fig. 2. Plate A.*

CIRCLE. A plane figure, bounded by a curve line which returns into itself, and which is every where equally distant from a point within, called its centre. It is the most capacious of all plane figures, and has many curious properties, described by mathematical writers. Its boundary is denominated the circumference, and a line passing from side to side through the centre is called the diameter. The proportion of the diameter to the circumference is, as unity, or one, to 3,14159265, or nearly as 7 to 22. *See Circle, Fig. 2. Plate A.*

CLAMPS. Those substantial strakes worked within side the ship, upon which the ends of the beams are placed. *See Midship Sections, Plate 8.*

CLAMPS, HANGING. *See* Hanging Clamps.

CLEAN. A term generally used to express the acuteness or sharpness of a ship's body: as when a ship is formed very acute or sharp forward, and the same aft, she is said to be *clean* both forward and aft.

CLEATS. Pieces of wood, of various shapes, according to their uses, either to resist or support great weights, as Fig. 3, on Plate A, called a *Wale-cleat;* Fig. 4 and 5, *Shore-cleats;* and Fig. 6. a *Tapered-cleat,* bolted under beams to support them where pillars are not used.

CLINCHER-BUILT. A term applied to the construction of some vessels and boats, when the planks of the bottom are so disposed, that the lower edge of every plank overlays the next under it, and the fastenings go through and clinch or turn upon the timbers. It is opposed to the term Carvel-work. *See Section of the Life Boat, Plate 26.*

CLINCHING or Clenching. Spreading the point of a bolt upon a ring, &c. by beating it with a hammer, in order to prevent its drawing.

CLOSE-QUARTERS. Strong barriers or bulkheads stretching athwart a merchant ship in several places, and behind which the crew may retreat when boarded by an enemy. They are therefore fitted with several small loop-holes, through which the small arms may be fired, with other conveniences for the defence of the ship, and the annoyance of the adversary.

COACH or COUCH. An apartment before the Captain's cabin. *See Plans, Plate 6.*

COAMING CARLINGS. Those Carlings that inclose the bomb-beds of bomb-vessels, and which are called Carlings because they are shifted occasionally:

COAMINGS. The raised borders of oak about the edge of the hatches and scuttles, which prevent water from flowing down from off the deck. Their inside upper edge has a rabbet to receive the gratings. *See Inboard Works, Plate* 4, *and Plans, Plates* 5 *and* 6.

COAT. A covering of paint, or other materials, by which the ship's sides, &c. are defended from the weather. Hence we say, " Give her a good coat of paint, pitch, &c.

COBOOSE. A small shifting kind of house or galley to cover the fire place of some merchant ships. It generally stands against the barricade on the fore part of the quarter-deck.

COCKPIT. That part of the after platform, under the lower deck, between the store-rooms, where the wounded are taken down to be dressed in time of action, and where the Surgeon has a repository for his medicines, &c. *See Inboard Works, Plate* 4, *and Plans, Plate* 5.

TO COME UP. To cast loose the forelocks or lashings of a Sett, in order to take in closer to the plank.

COMPANION. In ships of war, the framing and sash lights upon the Quarter-Deck or Round-House, through which the light passes to the Commander's apartments; and, from the upper deck to the Gun or Mess Room in frigates. In merchant ships it is the birthing or hood round the ladder way, leading to the master's cabin, and in small ships is chiefly for the purpose of keeping the sea from beating down. *See Inboard Works, Plate* 4, *and Plans, Plate* 6.

COMPASS TIMBER. Any timber that is curved in its shape.

COMPASSING. Crooked or Curved.

CONE. In geometry, a solid figure, having a circle for its base, and its top terminated in a point or vertex, as *Fig.* 1 *and* 2, *in Plate B.*

When the axis of a cone is exactly vertical, or at right angles with its base, it is said to be a RIGHT-CONE, as Fig. 1. When otherwise, it is called a SCALENOUS OR OBLIQUE CONE, as Fig. 2.

A right-cone may be supposed to be generated by the revolution of a right angled triangle, about its perpendicular leg considered as the axis. If this leg or axis be greater than the base of the triangle, or radius of the circular base, then the cone is *acute-angled*, that is, the angle at its vertex is an acute angle. If the leg or axis be less than the base of the triangle, it will be an *obtuse angled cone*; and, if it be equal, the cone will be a *right angled one*. The general description of the generation of a cone may be considered thus. *See Fig.* 3. *Plate B.*

If a line AZ continually pass through the point A, turning upon that point as a joint, and the lower part of it be carried round the circumference BCDE of a circle; then the space inclosed between that circle and the path of the line is a Cone. The circle BCDE being the base, A the vertex, and the line AF from the vertex to the centre of the base, is the axis. The other part of the revolving line, produced above A, will describe another cone, called the *opposite cone*, having the same common vertex, and axis produced.

CONIC SECTIONS. The various figures which arise from the section or cutting of a cone by a plane.

The curves that generally pass under the name of Conic Sections are three, viz. the Ellipsis, Parabola, and Hyperbola; for, although the triangle and circle are formed by the vertical and horizontal sections of a cone, yet they are not usually considered as Conic Sections.

For, if a right cone be cut directly through its axis, the plane or superficies of that section will be a plane isosceles triangle, as HVG, fig. 4, formed by the lines HV and VG, the sides of the cone being the sides of the triangle; HG the diameter of the base of the cone will be the base of the triangle; and, its axis VC will be the perpendicular height of the same.

And, if a right cone be cut off in any part by a right line parallel to its base, the plane of that section will be a Circle, because the base of the cone is a circle. Such is hg, fig. 4.

If a right cone be cut any where by a right line that cuts both its sides, but not parallel to its base, as TS, fig. 5, the plane of that section will be an *Ellipsis*, commonly called an *Oval;* that is, an oblong or imperfect circle, having several diameters, and two particular centres.

If any cone be cut into two parts by a right line parallel to one of its sides, as SA, fig. 6, the plane of the section, viz. SbBABb, is called a *Parabola.*

If a cone be any where cut by a right line, either parallel to its axis, as SA, fig. 7. or otherwise, as xN, in such a manner that the intersecting line, when continued through one side of the cone, as at S or x, will meet with the other side of the cone if it be continued beyond the vertex V, as at T, then is the plane of that section, viz. SbBABb called an Hyperbola.

These five sections, namely, the *triangle, circle, ellipsis, parabola,* and *hyperbola,* are all the planes that can possibly be produced from a cone. But of them, the three last, as above mentioned, are alone called *Conic Sections,* both by ancient and modern geometers.

From the genesis of these sections it may be observed how one section degenerates into another. For an ellipsis being that plane of any section of the cone which is between the circle and parabola, it will be easy to conceive that there may be great variety of ellipses produced from the same cone; and, when the section comes to be exactly parallel to one side of the cone, then the ellipsis degenerates into a parabola. Now a parabola being that section whose plane is always exactly parallel to the side of the cone, cannot vary as the ellipsis may; for so soon as it begins to move out of that position of being parallel to the side of the cone, it degenerates either into an ellipsis or hyperbola. That is to say, if the section inclines towards the plane of the base of the cone, it becomes an ellipsis; but if it inclines towards the vertex, it then becomes an hyperbola, which is the plane of any section that falls between the parabola and the triangle: and, therefore, there may be as many varieties of hyperbolas produced from one and the same cone as there may be ellipses.

In short, a circle may change into an ellipsis, the ellipsis into a parabola, the parabola into an hyperbola, and the hyperbola into a plane isosceles triangle. And the centre of the circle, which is its focus, divides itself into two focuses, or foci, so soon as the circle begins to degenerate into an ellipsis: but when the ellipsis changes into a parabola, one end of it flies open, one of its foci vanishes, and the remaining focus goes along with the parabola until the latter degenerates into an hyperbola. And, when the hyperbola degenerates into a plane isosceles triangle, this focus becomes the vertical point of the triangle, namely the vertex of the cone. So that the centre of the base of the cone may be said to pass gradually through all the sections until it arrive at the vertex, still carrying its *latus-rectum* along with it.

The *latus-rectum*, last mentioned, called also *parameter*, is that constant right line which passes through all the three conic sections, as hg, fig. 4; TS, fig. 5; and AS in fig. 6 and 7. For the diameter of a circle, being that right line which passes through its centre or focus, and by which all other right lines drawn within the circle are regulated and valued, may be called the latus rectum of the circle; and though it loses the name of diameter when the circle degenerates into an ellipsis, yet it retains the name of *latus rectum* in all the sections, gradually shortening as the focus carries it along from one section to another, until at last both it and the focus become co-incident, and terminate in the vertex of the cone.

As the science of Conics is of the highest utility in the theory and practice of naval architecture, we have entered the more fully into an explanation of "*Conic Sections*." For, from the segments of circles, and various elliptical curves, are formed the moulds used for constructing the draughts and plans of ships; to which may be added, that the bows of all vessels are, or should be, constructed from the properties of the Cone.—We now proceed to the explanation of a few subordinate terms, and the methods of delineating the three sections, in order to keep the subject in one connected point of view. But, as it is not consistent with our plan to describe all the properties of these figures, those who wish for more information upon the subject may consult the treatises of Dr. Hutton, and other celebrated mathematicians.

The terms which now remain to be defined are, *Ordinate*, *Semi-ordinate*, *Abscisse*, *Transverse* and *Conjugate Axes*, and *Parameter*.

1. ORDINATES. In general, a right line or lines parallel to each other, drawn at right angles to the axis, and reaching from one side of the section to the other, as the lines GGGG in fig. 8. A SEMI-ORDINATE is the half of an ordinate, as KG.

2. An ABSCISSE, or Abscissa, is that part (AP, fig. 9.) of the diameter of a curve line intercepted between the vertex A of that diameter and the point P, where any ordinate, or semi-ordinate, MP, to that diameter, falls. From this definition it will appear that there are an infinite number of variable abscisses in the same curve as well as an infinite number of ordinates. The use of the abscisses is, in conjunction with the ordinates, to express the nature of the curves. In the common parabola, each ordinate, as PQ, fig. 8, has but one abscisse, PA; in the ellipse the ordinate has two abscisses, BM, MA, (fig. 10.); in an hyperbola, fig. 11, it has also two, but they lie both on the same side; and in other curves may have more.

3. TRANSVERSE AXIS and CONJUGATE AXIS. As the axis is a right line dividing the section into two equal parts and cutting all its ordinates at right-angles, if CB, fig. 8, be drawn so as to cut the ordinate OPQ at right angles, and divide the section into two equal parts, then is the line CB the axis of the section. The transverse, first, or principal axis of an ellipse, or hyperbola, is the axis AB, which in the ellipse, fig. 10, is the longest, and in the hyperbola, fig. 11, cuts the curves in the points A and B. The *conjugate*, or second, axis of an ellipsis is the line CD in fig. 10, drawn through the centre, parallel to the ordinate, and perpendicular to the transverse axis AB, being the shorter of the two and terminated by the curve. The conjugate axis of an hyperbola is the right line EF fig. 11, drawn through the centre C, parallel to the ordinates gH, gH, and perpendicular to the transverse axis AB. In the ellipsis and hyperbola there are two axes and no more; and, in the parabola, only one axis.

4. Parameter. A certain constant right line, in each of the three conic sections, otherwise called the *latus rectum*, above mentioned. It is called *parameter* or *equal measurer*, because it measures the conjugate axis by the same ratio which is between the two axes themselves, being a third proportional to the transverse and conjugate axes in the ellipse and hyperbola; and, which is the same thing, a third proportional to an abscisse and its ordinate in the parabola. It is also equal to the double ordinate drawn through the focus of any of the three sections.

To describe an Ellipse or Ellipsis. Let AB (fig. 10.) be the transverse, GD the conjugate, and C the centre. With the radius AC describe an arch from the point G, cutting AB in the points Ee, which are called the two foci of the ellipse.

Assume a number of points, as fgh in the transverse AB, then with the radii Ah, Bh, and centres Ee, describe the arcs intersecting in I, which will give one point in the ellipse, and so with the radii Ag, Af, Bg, Bf, may other points be found.

And thus, by assuming a number of points, as f, g, h, in the transverse, may be found as many points II in the curve as may be desired. Then, with curve moulds, draw the figure through all these points.

A more expeditious method is with a thread, thus : Take a thread of the length of the transverse AB, and fasten its ends with two pins in the foci Ee, then stretch the thread, and it will reach to F in the curve; and, by moving a pencil round within the thread, keeping it always stretched, it will trace out the ellipse.

There are other methods of describing an Ellipsis, but the above are the most general.

To describe or construct a Parabola.—AP (fig. 8.) being an abscisse, and PQ its given ordinate, bisect PQ in D, join AD, and draw DB perpendicular to AD; then transfer PB to AF and AC in the axis produced, so shall F be what is called the focus.

Draw several double ordinates GHG, &c. then with the radii CH, CF, CI, CK, &c. from the centre F, describe arches cutting the corresponding ordinates in the points GGG, &c. Lastly, with curve moulds, draw the parabolic curve through all these points.

To construct or describe an Hyperbola. Let C (fig. 11.) be the middle of the Hyperbola, or the middle of the transverse AB, and BD perpendicular to AB, and equal to half the conjugate. With the radius CD describe an arch from the centre C, meeting AB, produced, in Ee, which are the two focus points of the hyperbola.

Then, assuming several points f, g, h, i, in the transverse AB, produced, with the radii Af, Bf, and centres Ee, describe arches intersecting in the several points k, k, which will be points in the hyperbola, and so on with the radii Ag, Ah, Ai, Bg, Bh, Bi.

And thus, by assuming a number of points as fghi, with the transverse AB produced, there will be found as many points K in the curve, or as many more as you please. Then, by curve moulds, draw the hyperbolic curve through all these points.

We have before observed, that the best lines for velocity may be constructed from the curves arising from the cone. It is for this reason that we have given the construction of the Ellipsis, Parabola, and Hyperbola, as by these the artist may shape his moulds for delineating ships' bodies, or water-lines on the draught, &c.

CONOID. In geometry, a solid body generated by the revolution of a conic section about its axis. *See* CONIC SECTIONS.

An ELLIPTICAL CONOID is a solid formed by the revolution of an ellipsis about one of its diameters, and more generally called a SPHEROID.

A HANGING CONOID is formed by two cones joined together at their base, to which form a ship's body at the floor is somewhat similar when there is much rising.

An HYPERBOLICAL CONOID is generated by the revolution of an hyperbola about its axis. *See* HYPERBOLA.

A PARABOLICAL CONOID is generated by the revolution of a parabola abouts its axis. *See* PARABOLA.

CONVERSION. The art of lining and moulding timber, plank, &c. with the least possible waste.

COPING. Turning the ends of iron lodging knees so as they may hook into the beams.

COUNTER. A part of the Stern; the *Lower Counter* being that arched part of the stern immediately above the wing transom. Above the Lower Counter is the *Second Counter*, the upper part of which is the under part of the Lights or Windows. The Counters are parted by their rails, as the lower counter springs from the tuck-rail, and is terminated on the upper part by the lower counter-rail. From the upper part of the latter springs the upper or second counter, its upper part terminating in the upper counter rail, which is immediately under the Lights. *See Sheer Draught and Perpendicular View of the Stern, Plate* 1.

COUNTER-MOULD. The converse of the Mould. *See* MOULDING.

If, when a piece of timber, moulded on both sides, as Breast-hooks, Riders, &c. is intended to fay at once, the operation is performed thus: After one edge is accurately shaped to the Mould, the windings or bevelling are taken square from the piece, and accurately applied to the part to which it is to be fayed, and two or three square spots set on the counter side. Then the counter mould is laid on the piece, to answer the corresponding square spots, and they agreeing, the piece may be trimmed through to the first moulding edge and will not fail to answer.

COUNTER RAILS. The ornamented rails athwart the stern into which the counters finish. *See Sheer Draught and Perpendicular View of the Stern, Plate* 1.

COUNTER-SUNK. The hollows in iron-plates, &c. which are excavated by an instrument called a Counter Sunk Bitt, to receive the heads of screws or nails so that they may be flush or even with the surface.

COUNTER TIMBERS. The right-aft timbers which form the stern. The longest run up and form the lights, while the shorter only run up to the under part of them, and help to strengthen the counter. The side counter timbers are mostly formed of two pieces scarphed together in consequence of their peculiar shape, as they not only form the right-aft figure of the stern, but partake of the shape of the topside also. *See Sheer Draught and Perpendicular View of the Stern, Plate* 1.

COVE. The arched moulding sunk in at the foot or lower part of the taffarel. *See Sheer Draught and Perpendicular View of the Stern, Plate* 1.

CRAB. A sort of little Capstan, formed of a kind of wooden pillar, whose lower end works in a socket, whilst the middle traverses or turns round in partners which clip it in a circle. In its upper end are two holes to receive bars, which act as levers, and by which it is turned round and serves as a capstan for raising of weights, &c. By a machine of this kind, so simple in its construction, may be hove up the frame timbers, &c. of vessels when building. For this purpose it is placed between two floor timbers, while the partners which clip it in the middle may be of four or five inch plank fastened on the same floors. A block is fastened beneath in the slip, with a central hole for its lower end to work in. Besides the Crab here described, there is another sort, which is shorter and portable. The latter is fitted in a frame composed of cheeks, across which are the partners, and at the bottom a little platform to receive the spindle. *See the figures of Crabs, Plate C.*

CRADLE. A strong frame of timber, &c. placed under the bottom of a ship in order to conduct her steadily in her ways till she is safely launched into water sufficient to float her. *See Frigate and Launch, Plate* 9.

CRANK. A term applied to ships built too deep in proportion to their breadth, and from which they are in danger of over-setting.

CRANKS. Pieces of iron shaped as an elbow, &c. and attached to the beams of the quarter deck for the capstan bars to be stowed thereon; (*See Midship Sections, Plate* 8.) or which are driven in the upper part of the taffarel, to support the stern lanterns. *See Sloop of War, Plate* 10.

CROAKY. A term applied to plank when it curves or compasses much in short lengths.

CROSS-CHOCKS. *See* Chocks.

CROSS-SPALES. Deals or fir plank nailed in a temporary manner to the frames of the ship at a certain height, and by which the frames are kept to their proper breadths, until the deck-knees are fastened. The main and top-timber breadths are the heights mostly taken for spalling the frames, but the height of the ports is much better, yet this may be thought too high if the ship is long in building.

CROSS-PIECES. The pieces of timber bolted athwartships to the Bitt-pins, for taking turns with the cable, or belaying ropes to. (*See Inboard Works, Plate* 4, *and Plans, Plate 5 and* 6.) Also a rack, with belaying pins through it, extending from the Carrick-bitts over the Windlass of a merchant ship.

CROW. An iron lever used to prize about the timbers, or any weight, particularly when in such a situation as not to be handled. Crows are of various sorts, some are opened at the end with a claw for drawing nails, others have a moveable staple at the end for drawing small bolts or large nails. The latter are commonly called *Engine Crows.*

CROW-FOOT. The same as Beam-Arm. *See* Beam-Arm.

CRUTCHES or CLUTCHES. The crooked timbers fayed and bolted upon the footwaling abaft for the security of the heels of the half-timbers. (*See Inboard Works, Plate* 4.) Also stantions of iron or wood whose upper parts are forked to receive rails, spare masts, yards, &c. *See Yacht, Plate* 12.

CUDDY. The Cabin abaft, under the roundhouse of East India ships, for the Captain's apartment. *See Plate* 15.

CUP. A solid piece of cast-iron, let into the step of the Capstan, and in which the iron spindle at the heel of the capstan works. *See Capstan, Plate* 7.

CURVE. In geometry, a line which, running in several directions, may be cut by a right line in more points than one.

For Inflection of a Curve, *see* Inflection.

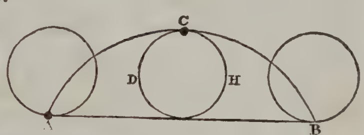
For the genesis of particular curves, as the *Epicycloid, Cycloid,* &c. see the respective articles in the alphabetical arrangement.

CUTTER. A swift sailing vessel with one mast, more particularly described hereafter. For the Cutters of Ships, *see* Boats.

CUTTER-BRIG. *See* Brig.

CUTTING-DOWN LINE. The elliptical curve line, forming the upperside of the floor-timbers at the middle line. Also the line that forms the upper part of the Knee of the Head above the Cheeks. *See Sheer Draught, Plate* 1, on which the cutting down line is represented as limiting the depth of every floor timber at the middle line, and also the height of the upper part of the dead wood afore and abaft.

CUTWATER. The Knee of the Head. *See* that Article.



CYCLOID. In geometry, a curve of the transcendental kind, called also *trochoid.* It is generated in the following manner. If the circle CDH roll on the given strait line AB, so that all the parts of the circumference be applied to it one after another, the point C that first touched the line AB in A, by a motion thus compounded of a circular and rectilinear motion, will describe the curve ACB, called the *Cycloid.*

CYLINDER. In geometry, a solid body, in form of a rolling stone, supposed to be generated by the rotation of a parallelogram about one of its sides.

DAGGER. A piece of timber that faces on to the poppets of the bilgeways, and crosses them diagonally, to keep them together. The plank that secures the heads of the poppets is called the *Dagger Plank.* The word *Dagger* seems to apply to any thing that stands diagonally or aslant. *See Frigate and Launch, Plate* 9.

DAGGER-KNEES. Knees to supply the place of hanging knees. Their side arms are brought up aslant or nearly to the underside of the beams adjoining. They are chiefly used to the lower deck beams of merchant ships, in order to preserve as much stowage in the hold as possible. Any strait hanging knees not perpendicular to the side of the beam are in general termed *Dagger-Knees.*

DAGGER-PLANK. *See* Dagger, above.

DATA, in mathematics, are such things or quantities as are given or known, or assumed as known, in order to find thereby other things that are unknown.

DAVIT. A short beam of fir, trimmed eight square towards the outer-end, and used as a crane, whereby the flukes of the anchor are hoisted to the Gunwale without injuring the planks of the side.

DEAD-DOORS. Doors made of whole deal, with a slit deal lining, fitted in a rabbet to the outside of the gallery doors, and bolted within side, to prevent the water from flowing into the ship in case the quarter gallery should be carried away.

DEAD-EYES. Oblate pieces of elm, fixed at the outer edges of the Channels, with three holes in each of them, through which the laniards of the shrouds are reeved. *See Sheer Draught, Plate* 1, *and Sections, Plate* 8.

DEAD-FLAT. A name given to that timber or frame which has the greatest breadth and capacity in the ship, and which is generally called the *Midship Bend.* In those ships where there are several frames or timbers of equal breadth or capacity, that which is in the middle should be always considered as *Dead-Flat,* and distinguished as such by this character ⊕. The timbers before Dead-Flat are marked A, B, C, &c. in order; and those abaft Dead-Flat by the figures 1, 2, 3, &c. The Timbers adjacent to Dead-Flat, and of the same dimensions nearly, are distinguished by the characters (A) (B) &c. and (1) (2) &c. *See Sheer Draught, Plate* 1.

DEAD-LIGHTS. Shutters for the stern and gallery lights, to prevent the water from gushing into the ship in a high sea. They are made of whole deal, with slit deal linings, fitted on the outside, and bolted or otherwise fastened within, in bad weather.

DEAD-RISING, or Rising Line of the Floor. Those parts of the floor or bottom, throughout the ship's length, where the sweep or curve at the head of the floor timber is terminated or inflects to join the keel. Hence, although the rising of the floor at the midship-flat is but a few inches above the keel at that place, its height forward and aft increases according to the sharpness of form in the body. Therefore the rising of the floor in the *sheer plan,* is a curve line drawn at the height of the ends of the floor timbers; and limited at the main frame, or dead-flat by the dead rising: appearing in flat ships nearly parallel to the keel for some timbers afore and abaft the midship frame; for which reason these timbers are called *flats:* but in sharp ships it rises gradually from the main frame, and ends on the stem and post.

DEAD-WATER. The eddy water which the ship draws after her at her seat or line of floatation in the water, particularly close aft. To this particular great attention should be paid in the construction of a vessel, especially in those with square tucks, for such being carried too low in the water, will be attended with great eddies or much *dead-water.* Vessels with a round buttock have but little or no dead-water, because, by the rounding or arching of such vessels abaft, the water more easily recovers its state of rest. *See the following Chapter on the Action of Fluids, &c.*

DEAD-WOOD. That part of the basis of a ship's body, forward and aft, which is formed by solid pieces of timber scarfed together lengthwise on the keel. These should be sufficiently broad to admit of a stepping or rabbet for the heels of the timbers, that the latter may not be continued downwards to sharp edges; and they should be sufficiently high to seat the floors. Afore and abaft the floors the dead-wood is continued to the cutting down line, for the purpose of securing the heels of the Cant-timbers. *See Sheer Draught, Plate* 1.

DEAD WORK. *See* Supernatant.

DEALS. Fir Wood, of similar thickness to Plank.

DECKS. The Decks are in a ship what floors are in a house. They are to support the artillery, stores, &c. and, with the beams, to connect the ship together. Their names arise from their situation, as *Lower-Deck*, *Middle-Deck*, *Upper-Deck*, and *Quarter-Deck*. When a deck stretches fore and aft upon one line, without any falls or intervals, it is called a *Flush-Deck*. The space before the fore-most bulkhead, under the Quarter-Deck, is often called the *Half-Deck;* and, in some North Country ships, the steerage is frequently called by this name. *See Plans of the Decks, Plates* 5 *and* 6.

DEEP-WAISTED. A term signifying that the height of the topsides is much above the upper deck as they are in most vessels in the Royal Navy.

DEPTH in the HOLD. The height between the floor and the lower deck. This is one of the principal dimensions given for the construction of a ship. It varies according to the height at which the guns are required to be carried from the water; or, according to the trade for which a vessel is designed.

DIAGONAL LINE. A line cutting the body-plan diagonally from the timbers to the middle line. It is square with, or perpendicular to, the shape of the timbers, or nearly so, till it meets the Middle Line. *See Body Plan, Plate* 1.

DIAGONAL RIBBAND. A narrow plank, made to a line formed on the Half-breadth-plan, by taking the intersections of the diagonal line with the timbers in the body-plan to where it cuts the middle line in its direction, and applying it to their respective stations on the Half-breadth-plan, which forms a curve to which the ribband is made as far as the Cant Body extends, and the square frame adjoining. *See* RIBBANDS. *See also the Frontispiece.*

DISPOSITION. A draught or drawing representing the several timbers that compose the frame of the ship, so that they may be properly disposed with respect to the ports, &c. *See Disposition of the Frame, Plate* 2.

DOG. An iron implement used by shipwrights, having a fang at one, or sometimes at each, end, to be driven into any piece for supporting it while hewing, &c. Another sort has a fang in one end and an eye in the other, in which a rope may be fastened, and used to haul any thing along.

DOG SHORE. A Shore particularly used in Launching. *See Frigate and Launch, Plate* 9.

DOUBLING. Planking of ships' bottoms twice. It is sometimes done to new ships when the original planking is thought to be too thin; and, in repairs, it strengthens the ship, without driving out the former fastenings.

DOVE-TAIL. A score at the end of a piece of wood resembling the end of a dove's tail, and into which a corresponding piece is fitted. It is cut larger within than without for the purpose of holding the two pieces together the more firmly. *See Half Breadth Plan of the Cutter, Plate* 14.

DOVE-TAIL PLATES. Metal plates, formed like Dove-tails, and used to confine the heel of the stern-post and keel together. *See Frigate and Launch, Plate* 9.

DOWSING CHOCKS. Pieces fayed athwart the Apron and lapped on the Knight-heads or inside stuff above the upper deck.

DRAUGHT. The drawing or design of the ship, upon paper, describing the different parts, and from which the ship is to be built. It is mostly drawn by a scale of one quarter of an inch to a foot, so divided or graduated that the dimensions may be taken to one inch. *See Sheer Draught, Plate* 1.

DRAUGHT of WATER. The Depth of water a ship displaces when she is afloat. *See Sheer Draught, Plate* 1.

DROP. The fall or declivity of a deck, which is generally of several inches. Drops are also small foliages of carved work in the stern-munions, &c.

DRIFT-PIECES. Solid pieces, fitted at the drifts, to form the scroles. They are commonly mitered into the gunwale, but should rather be let in with square butts, as the caulking will stand better. *See Sheer Draught, Plate* 1.

DRIFTS. Those parts where the sheer is raised according to the heights of the decks or gangways, and where the rails are cut off and ended by scroles. *See Sheer Draught, Plate* 1.

DRIVER. The foremost spur on the bilgeways; the heel of which is fayed to the foreside of the foremost poppet, and cleated on the bulgeways, and the sides of it stand fore and aft. It is now seldom used.

DRUMHEAD. The head of a capstan, formed of semi-circular pieces of elm, which, framed together, form the circle into which the capstan-bars are fixed. *See Capstan, Plate* 7.

DRUXEY. A state of decay in timber with white spungy veins, the most deceptive of any defect.

DUBBING. Working with an adze.

DUMB PINTLE. *See* Pintle.

DUNNAGE-BATTENS. Pieces of oak or fir, about two inches square, nailed athwart the flat of the orlop, to prevent wet from damaging the cables, and to admit air. Dunnage battens are also used in Sail-rooms, and in Magazines, so as to form a vacant space beneath the sails and powder barrels. Dunnage, in general, signifies light wood, or similar materials, used to elevate the stowage.

EARS of Boats. The knee-pieces at the fore-part on the outside, at the height of the Gunwale. *See* Launch, *Plate* 25.

EDGING of PLANK. Sawing or hewing it narrower.

EKEING. Making good a deficiency in the length of any piece by scarphing or butting, as at the end of deck-hooks, cheeks, or knees. The *Ekeing* at the lower part of the Supporter under the Cathead, is only to continue the shape and fashion of that part, being of no other service. We make this remark because, if the Supporter were stopt short without an ekeing, it would be better, as it causes the side to rot, and it commonly appears fair to the eye in but one direction. The Ekeing is also the piece of carved work under the lower part of the Quarter-piece at the aft part of the Quarter-gallery. *See Sheer Draught, Plate* 1, *and Plans, Plates* 5 *and* 6.

ELEVATION. The orthographic draught, or perpendicular plan of a ship, whereon the heights and lengths are expressed. It is called by shipwrights the Sheer-Draught. *See Plate* 1.

ELLIPSIS or ELLIPSE. A curve returning into itself, and produced by the section of a Cone by a plane cutting both its sides, but not parallel to its base. *See* CONIC SECTIONS.

ELLIPTIC or ELLIPTICAL. Belonging to, or having some property of the Ellipsis.

ELLIPTICAL COMPASSES. A mathematical instrument or machine for describing with facility the figure of an ellipsis.

ENTRANCE. A term applied to the fore part of the ship under the load-water line; as, "She has a fine entrance," &c.

EPICYCLOID. In geometry, a curve generated by the revolution of a point of the periphery of a circle, by its rolling along the convex or concave side of the periphery of another circle, in the same manner that the Cycloid is described by the motion of a circle on a strait line. *See* CYCLOID.

EVEN KEEL. A ship is said to swim on an even keel when she draws the same quantity of water abaft as forwards.

EYE-BOLT. *See* BOLTS.

FACE-PIECE. A piece of elm, generally tabled on to the fore part of the Knee of the Head, to assist the conversion of the main piece, and likewise to shorten the upper bolts, and prevent the cables from rubbing against them as the knee gets worn. *See Sloop of War, Plate* 10.

FACING. Letting one piece, about an inch in thickness, on to another, in order to strengthen it.

FAIR. A term to denote the evenness or regularity of a curve or line.

FALL. The descent of a deck from a fair curve lengthwise, as frequently in the upper deck of yachts, or merchant ships, to give height to the commander's cabin, and sometimes forward at the hawse-holes.

FALLING-HOME, or, by some, TUMBLING-HOME. The inclination which the topside has within from a perpendicular. *See* FLAIRING.

FALSE-KEEL. A second keel, composed of elm-plank, or thick stuff, fastened in a slight manner under the main keel, to prevent it from being rubbed. Its advantages also are, that, if the ship should strike the ground, the false keel will give way, and thus the main keel will be saved; and it will be the means of causing the ship to hold the wind better. *See Sheer Draught, Plate* 1.

FALSE-POST. A piece tabled on to the aft part of the heel of the main part of the stern post. It is to assist the conversion and preserve the main post should the ship tail aground. *See Sheer Draught, Plate* 1.

FALSE-RAIL. A rail fayed down upon the upper side of the main, or upper rail of the head. It is to strengthen the head-rail, and forms the seat of ease at the after end next the bow.

FASHION PIECES. The timbers so called from their fashioning the after part of the ship in the plane of projection, by terminating the breadth and forming the shape of the stern. They are united to the ends of the transoms and to the dead-wood. *See Sheer Draught, Plate* 1, *and Laying-off, Plate* 4.

To FAY. To join one piece so close to another that there shall be no perceptible space between them.

FENDERS. Two pieces of oak plank fayed edgeways, perpendicularly, against the topsides abreast the main hatchway, to prevent the sides of the ship from being rubbed by the hoisting of any thing on board. It appears, however, from the construction of these Fenders, that their only use, in the Royal Navy, can be, when any thing is to be parbuckled up the side; and, as this is very uncustomary, most weights being hoisted on board by the yard-tackles, or a derrick, so that the articles never touch the sides, they are of little use, and had better be dispensed with, as they are the means of rotting the sides in the parts on which they are affixed. *See Sheer Draught, Plate* 1.

FIFE-RAIL. A rail formerly let over the timber heads above the Plank-sheers of the quarter-deck and forecastle, and formerly worked similar to the plank-sheer, but lately planked up to it, excepting the Taffarel Fife Rail. *See Stern, Plate* 1.

FIGURE. The principal piece of carved work or ornament at the head of the ship. *See Sloop of War, Plate* 10.

FILAMENT OF A STREAM. *See* STREAM.

FILLING ROOM. A small place in the Magazine, and lined with lead, and wherein the powder is started loosely to fill the cartridges. *See Plans, Plate* 5.

FILLING-TIMBERS. The intermediate timbers between the frames that are gotten up into their places singly after the frames are ribbanded and shored. *See Disposition, Plate* 2.

FILLINGS. Pieces of fir fayed between the cheeks of the Head; and the pieces in general, to which no particular denomination is otherwise given, applied or affixed wherever solidity is required: such as those, of oak, between the floors to which the kelson is fayed; and, between the timbers, to receive the chain and preventer bolts, &c.

FINISHINGS. The carved ornaments of the Quarter Galleries. Those below the lower stool are called the *Lower-finishings*; and those above the upper stool, the *Upper-finishings*. *See Sheer Draught, Plate* 1.

FIRE HEARTH. The fire-place and conveniencies in the Gallery for cooking the provisions for the people. It is composed of a grate, iron-boilers, ovens, a smoke-jack, &c.

FISH-ROOM. A place parted off in the after-hold, by bulkheads, between the Spirit-Room, Bread-Room, and Powder-Room. It was formerly used for stowing the salt-fish to be consumed on board, a practice long since discontinued. It is now used for the stowage of coals, and sometimes for spirits, when the ship is destined for a long voyage. *See Inboard Works, Plate* 4.

FIXED-BLOCKS. Those blocks that come through the sides and are bolted, as the Sheet, Tack, and Brace, Blocks. *See* BLOCKS. *See also Disposition of the Frame, Plate* 2.

FLAIRING. The reverse of *Falling* or *Tumbling-Home*. As this can be only in the fore-part of the ship, it is said that a ship has a *flairing-bow*, when the topside falls outward from a perpendicular. Its uses are, to shorten the Cathead, and yet keep the anchor clear of the bow. It also prevents the sea from breaking in upon the Forecastle. *See the Sloop of War, Plate* 10.

FLATS. A name given to the timbers a-midships that have no bevellings, and are similar to dead-flat, which is distinguished by this character ⊕. *See* DEAD-FLAT. *See also Sheer Draught, Plate* 1.

FLEXURE. The bending or curving of a line or figure. *See* INFLECTED CURVES.

FLIGHT. A sudden rising, or a greater curve than sheer, as the cheeks, Catheads, &c.

FLIGHT of the TRANSOMS. As the ends or arms of the transoms, being gradually closed in proportion to their distance from the Wing transom, downwards, become more narrow as they approach the keel, the general figure or curve which they thus describe, similar to the rising of the Floors, is called the *Flight of the Transoms.*

FLOOR. The bottom of a ship, or all that part on each side of the keel which approaches nearer to a horizontal than a perpendicular direction, and whereon the ship rests when aground.

FLOOR-HOLLOW. The inflected curve that terminates the floor next the keel, and to which the *floor hollow mould* is made. *See Moulds, Plate* 1 *of Laying-off.*

FLOOR-RIBBAND. The ribband next below the floor-heads which supports the floors. This ribband should be well shored, and great pains should be taken to keep it fair and level, as the whole fabric depends very much thereon. *See Plate* 1, *of Laying-off.*

FLOOR SWEEPS. The Radii that sweep the heads of the Floors. *See* FRAMES. *See also Sheer Draught and Body Plan, Plate* 1.

FLOORS, or FLOOR TIMBERS. The timbers that are fixed athwart the keel, and upon which the whole frame is erected. They generally extend as far forward as the fore-mast, and as far aft as the after square timber; and, sometimes, one or two cant-floors are added. *See* FRAMES. *See also Midship Sections, Plate* 8.

FLUSH. With a continued even surface: As A FLUSH DECK, which is a deck upon one continued line, without interruption, from fore to aft.

FOCUS, in geometry and conic sections. Certain points in the parabola, ellipsis, and hyperbola, where the rays reflected from all parts of these curves concur and meet. *See* CONIC SECTIONS.

The FOCI of an ELLIPSIS are two points in the longest axis, from which, as centres, the figure is described.

If from the Foci two right lines be drawn, meeting each other in the periphery of the ellipsis, their sum will be equal to the longest axis; and therefore when an ellipsis and its two axis are given, and the foci are required, you need only take half the longest axis with compasses, and setting one foot in the end of the shorter, the other foot will cut the longer in the focus required.

The FOCUS of an HYPERBOLA is that point in the axis through which the *latus rectum* passes; when, if any two right lines are drawn meeting in either of the opposite hyperbolas, their difference will be equal to the principal axis.

The FOCUS of A PARABOLA, is a point in the axis within the figure, distant from the vertex one-fourth part of the *latus rectum.*

FOOT SPACE RAIL. The rail that terminates the foot of the balcony, and in which the ballasters step, if there be no Pedestal Rail. It rabbets over the ends of the deals of the deck. *See Sheer Draught and Perpendicular View of the Stern, Plate* 1.

FOOT-WALING, or Futtling, or Ceiling. The inside plank of the ship's bottom. *See Midship Sections, Plate* 8.

FORE. The distinguishing character of all that part of a ship's frame and materials which lie toward the stern.

FORE and AFT. In the direction of the ship's length from head to stern.

FORE BODY. That part of the ship's body, afore the Midships or Dead-flat. *See* Bodies. This term is more particularly used in expressing the *figure* or *shape* of that part of the ship. *See Body Plan, Plate* 1.

FORE-CASTLE. The short deck above the upper deck forward. *See Plans, Plate* 6.

FORE-FOOT. The foremost piece of the Keel. *See Sheer Draught, Plate* 1.

FORE-LOCK. A thin circular wedge of iron, used to retain a bolt in its place, by being thrust through a mortise hole at the point of the bolt. It is sometimes turned or twisted round the bolt to prevent its drawing.

FORE-MOST. Nearest to the head of the ship.

FORE-PEEK. Close forward under the lower deck. *See Inboard Works, Plate* 4, *and Plans, Plate* 5.

FORK-BEAM. *See* Beams.

FORWARD. In the fore-part of the ship.

FRAMES. The bends of timber which form the body of the ship; each of which is composed of one *floor-timber*, two or three *futtocks*, and a *top-timber* on each side; which, being united together, form the frame. Of these frames, or bends, that which incloses the greatest space is called the *midship* or *main frame* or *bend*. The arms of the floor timber form a very obtuse angle; and in the other frames, this angle decreases or gradually becomes sharper, fore and aft, with the middle line of the ship. Those floors which form the acute angles afore and abaft are called the *Rising Floors*. *See Body Plan, Plate* 1, *and Midship Sections, Plate* 8.

A frame of timbers is commonly formed by arches of circles called *Sweeps*, of which there are generally five: 1st. The *Floor Sweep*, which is limited by a line in the Body Plan perpendicular to the plane of elevation, a little above the keel; and the height of this line above the keel is called the *Dead Rising*. The upper part of this arch forms the head of the floor timber. 2nd. The *Lower Breadth Sweep;* the centre of which is in the line representing the lower height of breadth. 3rd. The *Reconciling Sweep;* this sweep joins the two former, without intersecting either; and makes a fair curve from the lower height of breadth to the rising line. If a straight line be drawn from the upper edge of the keel to touch the back of the floor sweep, the form of the midship frame below the lower height of breadth will be obtained. 4th. The *Upper Breadth Sweep;* the centre of which is in the line representing the upper height of breadth of the timber. This sweep described upwards forms the lower part of the top timber. 5th. The *Top-Timber Sweep*, or *Back Sweep*, is that which forms the hollow of the top-timber. This hollow is, however, very often formed by a mould, so placed as to touch the upper breadth sweep, and pass through the point limiting the half-breadth of the top-timber. *See Disposition of the Frame, Plate* 2. *See also the Frontispiece.*

FRAME TIMBERS. The various timbers that compose a frame bend; as the floor timber, the first, second, third, and fourth, futtocks, and top timber, which are united, by a proper shift, to each other, and bolted through each shift. They are often kept open, for the advantage of the air, and fillings fayed between them in wake of the bolts. Some ships are composed of frames only, and are supposed to be of equal strength with others of larger scantling. *See Disposition, Plate* 2. *See also Midship Sections, Plate* 8.

FRIEZING. The ornamental carving or painting above the drift-rails, and likewise round the stern or bow. It is generally a representation of foliage or emblematic trophies of war, &c.

FULCRUM. The prop of support of a lever in lifting or moving a heavy body.

FURRENS. Pieces to supply the deficiency of timber the moulding way.

FUTTLING. *See* FOOTWALING.

FUTTOCKS. The separate pieces of timber of which the frame timbers are composed. They are named according to their situation, that nearest the keel being called the first futtock, the next above, the second futtock, &c. *See* FRAMES. *See also Midship Sections, Plate* 8.

GALLERY. The long narrow compartment, or balcony, projecting from the stern and quarters of a large ship. The Stern gallery is usually decorated with a ballustrade. *See* QUARTER GALLERIES. *See also Sheer Draught, Plate* 1.

GALLEY. The place appointed for the fire-hearth and the use of the cooks. It is generally under the Forecastle or the fore part of the ship. *See Plan of Upper Deck, Plate* 6.

GAMMONING-HOLE. A mortise hole cut through the knee of the head, between the cheeks, through which the rope passes that gammons the bowsprit. *See Sloop of War, Plate* 10.

GANGBOARDS. The narrow platforms within the sides, next the Gunwales, which connect the quarter deck to the forecastle. Each is composed of three or four Prussia deals fayed and bolted together edgewise. *See Plan of Quarter Deck and Forecastle, Plate* 6.

GANGWAY. The entrance into the ship by the steps on the side, which, of course, is best when flush with the quarter-deck. *See Sheer Draught, Plate* 1, *and Plan of Quarter Deck and Forecastle, Plate* 6.

A FIXT GANGWAY is a continuation of the quarter-deck to a knee before it, so as to form the gangway when the quarter-deck of itself reaches not forward enough. There is sometimes a fixed gangway, made at the aft part of the forecastle in large ships, when the waist is longer than the customary length of a deal. *See Plan of Quarter-Deck and Forecastle, Plate* 6.

GARLANDS. *See* SHOT-GARLANDS.

GARBOARD STRAKE. That strake of the bottom which is wrought next the keel, and rabbets therein. *See Planking, Plate* 3.

GENESIS, among mathematicians, signifies the formation or production of some figure or quantity.

GENERATING LINE, or FIGURE, in Geometry, is that line, which by its motion produces any plane or solid figure. Thus a right line moved any way parallel to itself generates a parallelogram; moved round a point in the same plane with one end fastened in that point, it generates a circle. One entire revolution of a circle, in the same plane, generates the cycloid; and the revolution of a semi-circle round its diameter generates a sphere. *See* Cycloid and Sphere.

GOOGINGS or Gudgeons. The hinges upon which the rudder traverses. *See Rudder, in Sheer Draught, Plate* 1. Also the the metal pieces upon which a windlass works.

GOOSE-NECK. A large iron hook fixed with a strap at the after end of the main channel to stow the studding-sail boom in.

A shifting goose neck is a sort of iron cleat confined near the foremost end of the Tiller by means of thin iron plates, one on each side, which are bolted through the tiller, so that the goose-neck may move forward between the plates as in a grove. Its use is to shift forward as the tiller may shrink and go aft, to be kept fast in the rudder. The goose-neck is fastened by two screw eye-bolts, which go through it, and jamb it upon the tiller. *See* the Tiller and Goose-neck in the *Inboard Works, Plate* 4, *and Upper Deck Plan, Plate* 6.

GRAIN-CUT. Cut athwart the grain; as when the grain of the wood does not partake of the shape required. For instance, if a knee be cut out of a broad straight grained plank, it is evident that the grain being cut across, would be very short in one or both the arms.

GRATINGS. The lattice coverings of the hatchways, which are made with openings to admit air, or light, by cross battens and ledges. The openings should never be so large as to admit the heel of a man's shoe, as they may otherwise endanger those who pass over them.

GRAVITY. That quality by which bodies naturally tend downwards and towards a centre.

Gravity may be considered as a property of matter, which, although not essential, is universal; and, in one sense, inseparable from it. That is, all matter, however modified, and all bodies, have a gravitation or attraction towards each other.

All bodies on or near the Earth have a gravity, or weight, or a tendency towards its centre, or at least perpendicular to its surface; and this law is found universally to hold with respect to all known bodies and matter in nature. It is therefore acknowledged as a principle or law of nature, that all bodies, and all the particles of all bodies, mutually gravitate towards each other.

Bodies immersed in fluids have two kinds of gravity, the one *absolute* and the other *relative*. By the former is meant the whole force wherewith a body tends downwards; and, by the latter, the excess of gravity whereby a body tends downwards more than the fluids which surround it.

Specific Gravity, called also relative, comparative, and apparent gravity, is that by which one body is said to be heavier or lighter than another of a different kind. Thus lead is said to be specifically heavier than cork; because, supposing an equal bulk of each, the one would be heavier than the other.

Hence it follows, that a body specifically heavier than another is also more dense; that is, contains a greater quantity of matter under the same bulk, because bodies weigh in proportion to the quantity of matter they contain.

If a solid be immersed in a fluid of the same specific gravity with itself, it will remain suspended therein, in whatever part of the fluid it is placed: but, if the body immersed is specifically heavier than the fluid, it will subside to the bottom. On the contrary, if the body is specifically lighter than the fluid, it will rise to the top.

A body being laid on the surface of a fluid specifically heavier than itself sinks in it till the immersed part has displaced a quantity of fluid whose weight is equal to that of the whole body: and a body suspended in a fluid specifically lighter than itself loses a part of its weight equal to that of the fluid of the same bulk. *See* SPECIFIC GRAVITY.

GRIPE. A piece of elm timber that completes the lower part of the knee of the head, and makes a finish with the fore-foot. It bolts to the stem, and is farther secured by two plates of copper in form of a horse-shoe, and therefrom called by that name. *See Sheer Draught, Plate* 1.

GROMMETS FOR BOATS. Wreaths of rope which confine the oars to the pins in the Gunwale.

GROUNDWAYS. Large pieces of timber, generally defective, which are laid upon piles driven in the ground, across the dock or slip, in order to make a good foundation to lay the blocks on, upon which the ship is to rest.

GUARD-IRONS. Carved or arched bars of iron fixed over the carved work of Yachts, &c particularly over the head and quarter pieces, to prevent their being damaged.

GUNNER'S STORE-ROOM. *See* STORE-ROOMS.

GUN-ROOM. The after part of the lower deck, parted off for the accommodation of the subaltern officers. *See Plans, Plate* 5.

GUNWALE. That horizontal plank which covers the heads of the timbers between the main and fore drifts. *See Sheer Draught, Plate* 1.

GUY. A rope extended from the head of sheers, and made fast at a distance on each side, by which they are kept steady.

HAIR BRACKET. The moulding which terminates the fore ends of the head rails, comes at the back of the figure, and breaks in fair with the upper cheek. *See Sheer Draught, Plate* 1.

HALF-BREADTH PLAN. *See* PLAN.

HALF-BREADTH OF THE RISING. A curve in the Floor plan, which limits the distances of the centres of the floor sweeps from the middle line of the body plan. *See Half-Breadth Plan, Plate* 1.

HALF-PORTS. A sort of shutters made of deal, and fitted to the stops of those ports which have no hanging lids. They have a hole cut in them for the gun to go through.

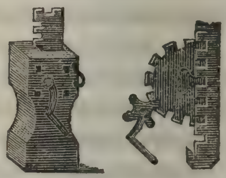
HALF-TIMBERS. The short timbers in the cant bodies which are answerable to the lower futtocks in the square body. *See Disposition, Plate* 2.

HAMMACOE or HAMMOCK RACKS. The battens nailed to the sides of the beams, and to which the sailors hang their hammocks and bedding.

HAMMERS. The tools used by shipwrights for driving nails and drawing bolts. *Claw-Hammers* are the most convenient for the former purpose, having a claw at one end to draw the nail out if it splits or rucks in driving. *Clench Hammers* should be made of hard steel, with one flat end for clenching, and a face for smoothing the clench.

HANCE or HANCH. A sudden fall or break, as from the drifts forward and aft to the waist. Also those breaks in the rudder, &c. at those parts where it suddenly becomes narrower. *See Sheer Draught, Plate* 1.

HANDSPEC. A wooden bar, made of tough ash, and used as a lever to prize or remove great weights.



HAND SCREWS or JACKS, double or single. The Engine represented in the margin, used to cant beams or other weighty timbers. It consists of a box of elm, containing cogged iron wheels, of increasing powers. The outer one, which moves the rest, is put in motion by a winch on the outside, and is called either single or double, according to its increasing force. The outer figure here shewn represents the inside work separately.

HANGING. Declining in the middle part from a horizontal right line, as the hanging of the decks, hanging of the sheer, &c.

HANGING-CLAMP. A semi-circular iron, with a foot at each end, to receive nails, by which it is fixed to any part of a ship, to hang stages to, &c.

HANGING-KNEE. Those knees against the sides whose arms hang vertically or perpendicular. *See Midship Sections, Plate* 8.

HARPINS. Pieces of oak, similar to ribbands, but trimmed and bevelled to the shape of the body of the ship, and holding the fore and after cant bodies together until the ship is planked. But this term is mostly applicable to those at the bow; hence arises the phrase "clean and full harpin," as the ship at this part is more or less acute. *See Plate* 8 *of Laying-off.*

HARRIS-CUT. This term is applied when the edges of planks are cut to an under bevelling, to fay one on another, as the birthing or sides of the well, so that no ballast may get in at the joints.

HATCHES. The covering for the Hatchways.

HATCHWAYS. The Square or oblong openings in the middle of the decks, for the convenience of lowering down goods; forming also the passages from one deck to another and into the Hold, &c. *See Plans of Decks, Plates 5 and* 6.

HAWSE-HOOK. The Breasthook over the Hawse-holes. *See Inboard Works, Plate* 4.

HAWSE-PIECES. The timbers which form the bow of the ship, whose sides stand fore and aft, or nearly so; that is, parallel to the middle line of the ship. *See Disposition, Plate 2, and Plate 7 of Laying-off.*

HEAD. The upper end of any thing; but more particularly applied to all the work fitted afore the stem, as the Figure, the Knee, Rails, &c. *See Sheer Draught, Plate* 1.

A Scroll Head signifies that there is no carved or ornamental figure at the head, but that the termination is formed and finished off by a *volute*, or scroll turning outwards. A Fiddle Head signifies a similar kind of finish, but with the scroll turning aft or inwards.

HEAD-LEDGES. The 'thwartship pieces which frame the hatchways and ladderways. *See Plans, Plates 5 and* 6.

HEAD-RAILS. Those rails in the Head which extend from the back of the figure to the cathead and bows, which are not only ornamental to the frame, but useful to that part of the ship. *See Sheer Draught, Plate* 1.

HEAD-TIMBERS. The pieces that cross the rails of the head vertically. They are bolted through their heels to the cutting-down of the knee, and unite the whole together. *See Sheer Draught, Plate* 1.

HEEL. The lower end of a tree, timber, &c. A ship is also said to *Heel* when she is not upright but declines towards the stern.

HEIGHT of BREADTH LINES, Upper and Lower. The two curved lines described on the Sheer-plan, at the height of the main-breadth, or broadest part of the ship, at each timber. In the Body-plan, they are horizontal lines at those heights on which the Main-breadths of each timber are set off. In those lines are found the centres for sweeping the lower and upper breadth sweeps. *See* Main Breadth. *See also Sheer Draught, and Body-plan, Plate* 1.

HELM. The whole of the machinery astern which serves to steer or guide the ship, as the rudder, the tiller, the wheel, &c. *See Inboard Works, Plate* 4.

HELM-PORT. That hole through the counter, through which the head of the rudder passes. *See Sheer Draught, Plate* 1.

HELM-PORT TRANSOM. The piece of timber placed athwart the inside of the counter timbers at the height of the Helm-Port. It is bolted through every stern timber, and knee'd at each end for the security of that part of the ship. *See Perpendicular View of the Stern, in Plate* 1.

HELVE. The handle of axes, adzes, mauls, &c.

HETEROGENEOUS or Heterogeneal. Any thing consisting of parts of dissimilar kinds, in opposition to *Homogeneous*. In mechanics, it is expressive of bodies of unequal density in different parts of their bulk; or of such whose gravities in different parts are not proportionable to the bulk of the whole; whereas bodies equally dense or solid in every part, or whose gravity is proportionable to their bulks, are said to be *homogeneous*.

HOGGING. *See* broken backed. A ship is said to *Hog* when the middle part of her keel and bottom are so strained as to curve or arch upwards. This term is therefore opposed to *Sagging*, which, applied in a similar manner, means, by a different sort of strain, to curve downwards.

HOLD. That part of the ship below the lower deck, between the bulkheads, which is reserved for the stowage of ballast, water, and provisions, in ships of war, and for that of the cargo in merchant-vessels.

HOLLOW-MOULD. The same with *Floor-Hollow*, which see. Sometimes the back sweep which forms the upper part of the top-timber is called the *Top-timber Hollow*. *See Moulds, Plate* 1 *of Laying-off.*

HOMOGENEOUS. Of a like kind throughout, and having the same nature and properties.

HOOD. The name given to all the foremost and aftermost planks of the bottom, both withinside and without. Also a covering to shelter the mortar in Bomb-vessels. In merchant ships it is the birthing round the ladder way. *See* Companion.

HOODING ENDS. Those ends of the planks which bury in the rabbets of the stem and stern post.

HOOK of the Decks. *See* Breast-hooks.

HOOKING. The act of working the edge of one plank, &c. into that of another, in such a manner that they cannot be drawn asunder endways. *See Kelson Scarphs, Inboard Works, Plate 4, and Sheer Strakes, Planking, Plate 3.*

HORIZONTAL RIBBANDS. Those ideal ribbands, used in laying off, which are taken off level or square with the middle line of the ship's body. *See* Ribbands.

HORN or HORNING. Placing or proving any thing to stand square from the middle line of the ship, by setting an equal distance thereon from each side of the middle line; then bringing the same distances equally from some fixed spot in the middle line by a batten or staff of some length.

HORSE. The round bar of iron which is fixed to the main rail and back of the figure in the Head, with stantions, and to which is attached a netting for the safety of the men who have occasion to be in the Head. Also the cross piece of timber tenoned on to the heads of the bitts for the booms to rest upon.

HORSE-IRON. An iron fixed in a handle, and used with a beetle by caulkers, to *horse-up* or harden in the oakum.

HORSE-SHOES. Large straps of iron or copper shaped like a horse-shoe and let into the stem and gripe on opposite sides, through which they are bolted together to secure the gripe to the stem.

HULL. The whole frame or body of a ship, exclusive of the masts, yards, sails, and rigging.

HYDROSTATICS. That science which treats of the weight, pressures, motion, and equilibria, of fluids; and which ought, therefore, to be thoroughly understood by every shipwright desirous of possessing a competent knowledge of the theoretic principles of his art.

Hydraulics is that part of Statics which considers the *motion* of fluids, with the application thereof to machinery, and is distinguished from *Hydrostatics* in this, that the latter is supposed merely to explain the equilibrium of fluids, or the gravitation of fluids at rest. From the immediate relation between the two, it however frequently happens, that they are considered as one, and indiscriminately denominated either *Hydrostatics* or *Hydraulics*.

HYPERBOLA. A figure made by the section of a cone. *See* Conic Sections.

JAMBS for fixing the Lights. Thick broad pieces of oak, fixed up endways, and between which the magazine lights are fitted. *See Magazine Plan, Plate 5.*

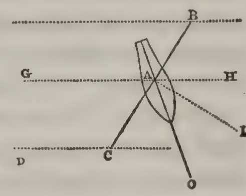
IMPETUS. The force with which one body strikes or impels another.

To IMPINGE. To dash or strike against; to clash with.

IMPULSION of a Fluid. The influence or action of a fluid in motion on a solid body, as of a stream or current of water on that of a ship.

Direct Impulse expresses the action of a particle, filament, or stream, of fluid, when meeting the surface perpendicularly, or when the surface is perpendicular to the direction of the stream.

Absolute Impulse means the absolute pressure on the impelled surface, arising from the action of the fluid, whether striking the surface perpendicularly or obliquely; or, it is the force impressed on the surface, or tendency to motion which it acquires, and must be opposed by an equal force in the opposite direction, in order that the surface may be maintained in its place. This pressure is always perpendicular to the surface: it having been determined, by universal experience, that the mutual actions of bodies on each other are always exerted in a direction perpendicular to the touching surfaces; as, when one billiard ball is struck by another, moving in any direction whatever, the first ball always moves off in the direction perpendicular to the plane which touches the two balls in the point of contact or impulse.



RELATIVE OF EFFECTIVE IMPULSE is the pressure on the surface estimated in some particular direction. Thus BC, in the annexed figure, may represent the sail of a ship, impelled by the wind blowing in the direction DC. AO may be the direction of the ship's keel, or the line of her course. The wind strikes the sail in the direction GH parallel to DC; the sail is urged or pressed in the direction AI, perpendicular to BC. But we are interested to know what tendency this will give the ship to move in the direction AO; and this is the *relative or effective impulse.*

The ANGLE of INCIDENCE of the wind (which has been already defined under the article ANGLE) is the angle contained between the direction of the wind GA and the plane BC.

The ANGLE of OBLIQUITY is the angle OAC contained between a plane, BC, and the direction AO, in which it may be required to estimate the impulsion of a fluid, &c. which comes in the direction GA.

IN AND OUT. A term sometimes used for the scantling of the Timbers the moulding way, but more particularly applied to those bolts in the knees, riders, &c. which are driven through the ship's sides, or athwartships, and therefore called "*In and out Bolts.*"

INBOARD. Within the ship; as the *Inboard Works,* &c. *See Plate* 4.

INCIDENCE. The direction in which one body strikes or falls upon another. The angle made by the line of direction upon the plane of the receiving body is called the *Angle of Incidence. See* ANGLE, and *Fig.* 2, *Plate A.*

INCLINED PLANE. A plane that makes an oblique angle with the horizon.

INFLECTED CURVES. Such curves as have a point of inflection, and which, being continued, turn a contrary way; as the water lines abaft, of ships in general.

INNER POST. A piece of oak timber, brought on and fayed to the foreside of the main sternpost, for the purpose of seating the Transoms upon it. It is a great security to the ends of the planks, as the main post is seldom sufficiently afore the rabbet for that purpose, and is also a great strengthener to that part of the ship. *See Inboard Works, Plate* 4.

INTERSECTION. The point in which one line crosses another.

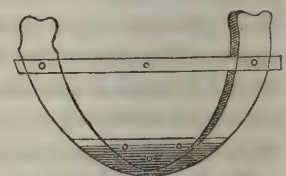
JOINT. The place where any two pieces are united. This term is, however, more particularly used to express the lines which are laid down in the mould-loft for the purpose of making the moulds for the timbers, as those lines exhibit the shape of the body between every two timbers, which is hence called the *Joint.*

IRONS. The tools used by the caulkers for driving in the oakum.

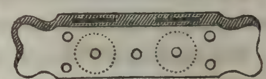
KEEL. The main and lowest timber of a ship, extending longitudinally from the stem to the stern post. It is formed of several pieces, which are scarphed together endways, and form the basis of the whole structure. Of course it is usually the first thing laid down upon the blocks for the construction of the ship. *See Sheer Draught, Plate* 1.

KEEL STAPLES. *See* Staples.

KEELSON or, more commonly, KELSON. The timber, formed of long square pieces of oak, fixed within the ship exactly over the keel, (and which may therefore be considered as the counter part of the latter) for binding and strengthening the lower part of the ship; for which purpose it is fitted to, and laid upon, the middle of the floor timbers, and bolted through the floors and keel. *See Inboard Works, Plate* 4.



KEVELS. Pieces of oak plank, shaped like timber heads, and fixed into mortises cut through other pieces that are fastened to the insides of the ship. They answer the purpose of timber heads to belay ropes to.



KEVEL or CAVEL HEAD BLOCKS. A Sort of Blocks, having a sheave hole or two, cut through fore and aft, and which are bolted to the ship's sides, nearly opposite the masts, to reeve the lifts, &c.

KEY. A dry piece of oak, &c. cut tapering, to drive into scarphs that have hook-butts.

KILN. A convenience for heating planks to make them pliable. A *Steam-Kiln* is a trunk composed of deals, grooved neatly into each other, which is generally from three to four feet square, and from forty to sixty feet in length, having a door at each end. It is confined together by bolts driven through it at certain distances, which answer for bearers to rest the plank upon, and it is supported upon brick-work. Beneath it, in the middle, is a large iron or copper boiler, or sometimes two boilers, which are then fixed near each end, the steam from which, issuing into the trunk, enters the pores of the plank and makes it pliable.

A *Boiler Kiln* is shaped similar to the former, but with an open top. It is formed of sheets of copper rivetted together, and is fixed in brick work. Under each end, or in the middle, are furnaces to make the water boil, when the plank is in. The upper part is covered with shutters that are hoisted occasionally by small tackles. The dimensions, &c. of a copper boiler in one of the Royal Yards are, length, forty feet; breadth, at the ends, four feet three inches, and in the middle, six feet; depth, two feet ten inches; and weight fifty-three cwt. three qrs. seven lb.

KNEES. The crooked pieces of oak timber by which the ends of the beams are secured to the sides of the ship. Of these, such as are fayed vertically to the sides are called *Hanging-Knees*, and such as are fixed parallel to, or with the hang of, the deck, are called *Lodging-Knees. See Midship Sections, Plate* 8, *and Plans of Gun-deck, Plate* 5.

KNEE TIMBER. That sort of crooked timber which forms, at its back or elbow, an angle of from forty-five to twenty-four degrees, with a line produced or continued in the direction of one of its outer sides. If it forms the greater angle, it is the more valuable on that account.

But if the angle so formed at the back be more acute, the wood is said to be *raking*, and is proportionally less valuable, being of the less utility for the formation of knees, &c.

KNEE of the HEAD. The large flat timber fayed edgeways upon the fore-part of the stem. It is formed by an assemblage of pieces of oak coaked or tabled together edgewise, by reason of its breadth, and it projects the length of the Head. Its fore-part should form a handsome serpentine line, or inflected curve. The principal pieces are named the *Main-piece* and *Lacing. See Sheer Draught, Plate* 1.

KNIGHT-HEADS, or Bollard Timbers. Large oak timbers fayed and bolted to each side of the stem, the heads of which run up sufficiently above the head of the stem to support the bowsprit, care being taken to cast them sufficiently open above the stem to the diameter of the bowsprit. *See Sheer Draught, Plate* 1.

KNUCKLE. A sudden angle made on some timbers by a quick reverse of shape, such as the knuckle of the counter-timbers, &c. *See Disposition of the Frame, Plate* 2.

KNUCKLE TIMBERS. Those top timbers in the fore body whose heads stand perpendicular, and form an angle with the flair or hollow of the topside. This work is the best when the touch or knuckle is at the plank sheer. *See Disposition of the Frame, Plate* 2.

LABOURSOME. Subject to *labour*, or to pitch and roll violently in a heavy sea, by which the masts and even the hull may be endangered. For, by a successive heavy roll the rigging becomes loosened, and the masts at the same time may strain upon the shrouds with an effort which they will be unable to resist; to which may be added, that the continual agitation of the vessel loosens her joints, and makes her extremely leaky.

LACING. One of the principal pieces that compose the Knee of the Head, which runs up to the top of the Hair-Bracket, and to which the figure and rails of the Head are secured. *See Plate* 8 *of Laying-Off.*

LADDERS. Ladders are in a ship for the same purpose as stairs in a house, for the convenience of ascending or descending from one deck to another.

LADDER-WAYS. The openings in the decks wherein the ladders are placed. *See Plans, Plates 5 and* 6.

LANDING STRAKE, in Boats. The upper strake but one.

LANTERNS. The machines made of tin and glass, to contain candles for the transmission of light to those parts of the ship where an unscreened candle cannot be placed, or where it would be dangerous, as on the Poop, in the Magazine, Store-rooms, &c.

To LAP OVER or UPON. The mast carlings are said to lap upon the beams by reason of their great depth, and head-ledges at the ends lap over the coamings.

LAPS. The remaining part of the ends of carlings, &c. which are to bear a great weight or pressure; such as the capstan-step. *See Inboard Works, Plate* 4, *and Capstan, Plate* 7.

LAP-SIDED. A term expressive of the condition of a vessel when she will not swim upright, owing to her sides being unequal.

LARBOARD-SIDE. The left-hand side of the ship, when looking forward from the stern.

LATUS RECTUM. In conic sections, the same with Parameter. *See* Conic Sections.

LAUNCH. The slip or descent whereon the ship is built, including the whole of the machinery used in Launching. *See Frigate and Launch, Plate* 9. *See also* Boats.

LAUNCHING. The act of sending the ship from off the slip into the water.

LAUNCHING-PLANKS. A set of planks mostly used to form the platform on each side of the ship, whereon the bilgeways slide for the purpose of launching. *See Frigate and Launch, Plate* 8.

LAYING-OFF, or Laying-down. The act of delineating the various parts of the ship, to its true size, upon the mould-loft floor, from the draught given, for the purpose of making the moulds. *See* Moulds. *See also the Laying-Off Plates.*

LAZARETTO. A name given to an hospital ship for the reception of the sick, or of persons supposed to be infectious. It is also the name of a place parted off at the fore part of the lower deck, in some merchant-ships, for the convenience of laying up the provisions, stores, &c. necessary for the voyage.

LEAN. The same with Clean, which see.

LEDGES. Oak or fir scantling used in framing the decks, which are let into the carlings athwartships. The ledges for gratings are similar, but arch or round up agreeable to the head ledges. *See Gun-deck Plan, Plate 5.*

LENGTHENING. The operation of separating a ship athwartships and adding a certain portion to her length. It is performed by clearing or driving out all the fastenings in wake of the butts of those planks which may be retained, and the others are cut through. The after end is then drawn apart to a limited distance equal to the additional length proposed. The Keel is then made good, the floors crossed, and a sufficient number of timbers raised to fill up the vacancy produced by the separation. The Kelson is then replaced to give good shift to the new scarphs of the Keel, and as many beams as may be necessary are placed across the ship in the new interval, and the planks on the outside are replaced with a proper shift. The clamps and footwaling within the ship are then supplied, the beams knee'd, and the ship completed in all respects as before.

To LET-IN. To fix or fit one timber or plank into another, as the ends of carlings into the beams, and the beams into the clamps, vacancies being made in each to receive the other.

LEVEL. Horizontal; or as a base square with a perpendicular.

LEVEL LINES. Lines determining the shape of a ship's body horizontally, or square from the middle line of the ship.

LEVELLED-OUT. A line continued out, in a horizontal direction, from the intersection of an angle; or, where the cant timbers may intersect the diagonal or ribband lines. *See Plates 3 and 4 of Laying-off.*

LEVER. A bar of iron or wood to raise weights. The first and most simple of the mechanic power. *See* Mechanics.

LIEUTENANT's STORE-ROOM. An apartment fitted up with shelves, bins, and lockers, on the starboard side of the after platform, for the use of the first lieutenant. *See Plans, Plates 5.*

LIGHT-ROOM. A small place parted off from the magazines, and in which the lights for lighting the magazine are contained. *See Plans, Plate* 5.

LIGHT WATER-LINE. *See* WATER-LINES.

LIMBER-BOARDS. *See* LIMBER-PASSAGE.

LIMBER HOLES. *See* the next article.

LIMBER PASSAGE. A passage or channel formed throughout the whole length of the floor, on each side of the kelson, for giving water a free communication to the pumps. It is formed by the LIMBER-STRAKE on each side, a thick strake wrought next the kelson, from the upper side of which the depth in the hold is always taken. This strake is kept at about eleven inches from the kelson, and forms the passage fore and aft which admits the water with a fair run to the pump-well. The upper part of the Limber Passage is formed by the LIMBER-BOARDS, which are made to keep out all dirt and other obstructions. These boards are composed of short pieces of oak plank, one edge of which is fitted by a rabbet into the limber strake, and the other edge bevelled with a descent against the kelson. They are fitted in short pieces for the convenience of taking up any one, or more, readily, in order to clear away any obstruction in the passage. When the limber boards are fitted, care should be taken to have the butts in those places where the bulkheads come, as there will be then no difficulty in taking those up which come near the bulkheads. A hole is bored in the middle of each butt to admit the end of a crow for prizing it up when required. To prevent the boards from being displaced, each should be marked with a line corresponding with one on the Limber Strake. *See Midship Sections, Plate* 8.

LIMBER HOLES are square grooves cut through the underside of the floor timber, about nine inches from the side of the Keel on each side, through which water may run toward the pumps, in the whole length of the floors. This precaution is requisite in merchant ships only, where small quantities of water, by the heeling of the ship, may come through the ceiling and damage the cargo. It is for this reason that the lower futtocks of merchant ships are cut off short of the Keel.

To LINE. To cover one piece with another. Also to mark out the work, or make lines upon the floor with a chalked line.

LINE of FLOATATION. *See* WATER LINES.

LIPS of SCARPHS. The substance left at the ends, which would otherwise become sharp, and be liable to split; and, in other cases, could not bear caulking as the scarphs of the keel, stem, &c.

LOAD WATER LINE. *See* WATER LINES.

LOBBY. A name sometimes given to an apartment close or next before the great cabin bulkhead. *See Plans, Plate* 6.

LOCKERS. Small compartments, built of deal, in the cabins and store-rooms. *See* SHOT GARLANDS.

LONG BOAT. The largest and stoutest boat belonging to a ship. *See* BOATS.

LONG TIMBERS. Those timbers afore and abaft the floors, which form the floor and second futtocks in one. *See Disposition of the Frame, Plate* 2.

LOOP-HOLES. Small apertures through the bulkheads, coamings, head-ledges, and other parts of merchant ships, through which the small arms are fired on an enemy who boards at close quarters.

LOOVERED BATTENS. The battens that inclose the upper part of the Well, which are fixed at such an angle as to admit air, and yet prevent any dirt from being thrown into the Well. *See Inboard Works, Plate* 4.

LOOVER-WISE or LOOVER-WAYS. To place battens or boards at a certain angle, so as to admit air but not wet. The loovered or battened parts of Ships'-Wells are fixed in this manner to admit air and prevent persons from throwing filth of any kind into the well. *See Well, in the Inboard Works, Plate* 4.

LOWER-BREADTH SWEEP. *See* FRAMES.

LUFF or LOOF. The fullest or roundest part of the bow.

MAGAZINE. The Apartment used to lodge the powder in; which, in large ships, is situated forward, and in small ships abaft. It should always be situated as low down as possible. *See Inboard Works, Plate* 4, *and Sloop, Plate* 10.

MAIN. Chief or Principal, as opposed to any thing secondary or inferior. Thus the main-mast is used in contradistinction to the fore or mizen mast; the main-keel, main wales, main-hatchway, &c. are in like manner distinguished from the false-keel, channel-wales, and the fore and after hatchways, &c.

MAIN BREADTH. The broadest part of the ship at any particular timber or frame, which is distinguished on the sheer-draught by the upper and lower heights of breadth lines. *See Sheer Draught, Plate* 1.

MAIN HALF-BREADTH. Half of the main breadth, and thus called because it is necessary to lay down on the plan but half of the figure of the ship, both sides being exactly alike. *See Sheer Draught, Plate* 1.

MAIN KEEL. The term of distinction between the Keel and the False-Keel.

MAIN POST. The same with STERN POST, and used to distinguish it from the false-post, and inner-post.

MAIN WALES. The lower Wales, which are generally placed on the lower breadth, and so that the main-deck knee-bolts may come into them. *See* WALES.

MALLET. A sort of wooden hammer too well known to need description. The mallet used by Caulkers to drive the oakum into the seams is in general very different from that of Shipwrights, as it is longer and more cylindrical, and is hooped with iron at each end of the head, to prevent its splitting and wearing in the exercise of caulking. North Country Shipwrights, who generally practise both branches, use the last mentioned mallet upon all occasions.

MANGER. An apartment extending athwart the ship immediately within the hawse-holes. It serves as a fence to interrupt the passage of water which may come in at the hawse-holes, or from the cable when heaving in; and the water thus prevented from running aft is returned into the sea by the manger scuppers, which are larger than the other scuppers on that account. *See Gun-deck Plan, Plate* 5.

MARGIN LINE. A line or edge parallel to the upper side of the wing transom, and about five inches below it, at which place terminate all the butts of the bottom planks abaft. The latter are made good by the tuck-rail. *See Perpendicular View of the Stern, Plate* 1.

MARINE CLOTHING ROOM. An apartment built on the larboard side of the after platform to receive the clothing of the Marines. *See Orlop Plan, Plate 5.*

MAST CARLINGS. Those large Carlings which are placed at the sides of the mast-rooms for the purpose of framing the partners. *See* CARLINGS. *See Inboard Works, Plate* 4, *and Plans, Plates 5 and* 6.

MAST ROOMS. The spaces between those beams where the Masts are to be fixed.

MASTS. The long cylindrical pieces of timber, elevated upon the Keel, and to which the yards and sails, &c. are attached. *See Sheer Draught, Plate* 1.

MAULS. Large hammmers used for driving treenails, having a steel face at one end and a point or pen drawn out at the other. Double-headed Mauls have a steel face at each end, of the same size, and are used for driving of bolts, &c.

MAXIMUM. In mathematics, the greatest quantity attainable in any given case.

MECHANICS. A science of the highest importance to the Shipwright; it being that which teaches the principles of motion and the construction of Engines or Machines. *See* MOTION.

Any machine or engine by which a man can raise a greater weight, or overcome a greater resistance, than he could by his natural strength without it, is called a *mechanical power*. To every machine of this sort a power is applied, in order to raise a weight or overcome a resistance. And the machine is so contrived, that the power which works it, shall move through a greater space, in the same time, than the weight or resistance moves through: for without this, no advantage can be gained by it.

The power or advantage gained by any machine, let it be ever so simple or ever so compound, is as great, as the space moved through by the working power is greater than the space through which the weight or resistance moves, during the time of working. Thus, if that part of the machine to which the working power is applied moves through 10, 20, 100, or 1000 times as much space as the weight moves through in the same time; a man who has just strength enough to work the machine will raise 10, 20, 100, or 1000 times as much by it as he could do by his mere natural strength without it. But then, the time lost will be always as great as the power gained. For it will take 10, 20, 100, or 1000 times as much time for the power to move through that number of feet or inches as it would do to move through one foot or one inch.

The simple machines, called *Mechanical Powers*, are six in number; viz. the Lever, the Wheel and Axle, the Pulley, the Inclined Plane, the Wedge, and the Screw. And of these all the most compound Engines consist. They are called Mechanical Powers, because they help us to raise weights, move heavy bodies, and overcome resistances, which we could not effect without them.

The foundation of all Mechanics is explained as follows. If we consider bodies in motion, and compare them together, we may do this either with respect to the quantities of matter they contain, or the velocities with which they are moved. The heavier any body is, the greater is the power required either to move it, or to stop its motion; and again, the swifter it moves, the greater is its force. So that the whole momentum or quantity of force of a moving body is the result of its quantity of matter multiplied by the velocity with which it is moved. And, when the products arising from the multiplication of the particular quantities of matter in any two bodies by their respective velocities are equal, the momenta or entire forces are so too. Thus suppose a body, which we shall call A, to weigh 40 pounds, and to move at the rate of two miles in a minute; and another body, which we shall call B, to weigh only four pounds, and to move 20 miles in a minute; the entire forces with which these two bodies would strike against any obstacle would be equal to each other, and therefore it would require equal powers to stop them. For 40 multiplied by 2 gives 80, the momentum or force of the body A; and 20 multiplied by 4 gives 80, the momentum or force of the body B.

Upon this easy principle depends the whole of mechanics; and it holds universally true, that when two bodies are suspended by any machine, so as to act contrary to each other, if the machine be put into motion, and the perpendicular ascent of one body, multiplied into its weight, be equal to the perpendicular descent of the other body multiplied into its weight, these bodies, however unequal soever in their weights, will balance one another in all situations: for, as the whole ascent of one is performed in the same time with the whole descent of the other, their respective velocities must be directly as the spaces they move through: and the excess of weight in one body is compensated by the excess of velocity in the other.

Upon this principle it is easy to compute the power of any mechanical engine, whether simple or compound; for it is but only inquiring how much swifter the power moves than the weight does (*i.e.* how much farther in the same time), and just so much is the power increased by means of the engine.

In the theory of this science, we suppose all planes perfectly even, all bodies perfectly smooth, levers to have no weight, machines to have no friction; and, in short, all imperfections to be set aside, &c.—*(Ferguson).*

MESSENGER. A large cable-laid rope used to heave in the cable by the main capstan.

META-CENTRE. That point in a ship above which the centre of gravity must by no means be placed; because, if it were, the vessel would be liable to overset. The *meta-centre,* which has also been called the *shifting-centre,* depends upon the situation of the centre of cavity; for it is that point where a vertical line drawn from the centre of cavity cuts a line passing through the centre of gravity, and being perpendicular to the Keel. *See* CENTRE, *and Sheer Draught, Plate* 1.

MIDDLE LINE. A line dividing the ship exactly in the middle. In the horizontal or half-breadth plan it is a right line bisecting the ship from the stem to the stern-post; and, in the plane of projection, or body plan, it is a perpendicular line bisecting the ship from the keel to the height of the top of the side.

MIDDLE TIMBER. That timber in the stern which is placed in midships.

MIDDLE WALES. The three or four thick strakes, worked along each side, between the lower and middle deck ports in three-decked ships. *See* WALES.

MIDSHIPS. The middle of the ship, either with regard to her length or breadth. *See* AMIDSHIPS.

MIDSHIP-BEND or FRAME. That bend which is called *Dead-Flat*. *See* BENDS. *See also Midship Sections, Plate* 8.

MITERED. If two pieces of wood, &c. be joined so as to make a right angle, and the two ends be put together so as to form a line making an angle of 45 degrees, the joint is said to be mitered.

MIZEN-MAST. That Mast, in a three-masted vessel, which is nearest the stern. *See Sheer Draught, Plate* 1.

MOMENTA, or MOMENTS. The plural of *Momentum*. *See the next Article.*

MOMENTUM of a heavy body, or of any extent considered as a heavy body, is the product of the weight multiplied by the distance of its centre of gravity from a certain point, assumed at pleasure, which is called the centre of the momentum, or from a line which is called the axis of the momentum.

In Mechanics, MOMENTUM in general signifies the same with impetus, or the quantity of motion or force in a moving body; which is always equal to the quantity of matter multiplied into the velocity. For example, the momentum of a body weighing 10 pounds, and moving with a velocity, suppose of 3 miles in a given time, is equal to that of a body of 5 pounds moving with a velocity equal to 6 miles in the same time. For $10 \times 3 = 30$; so also $5 \times 6 = 30$. *See* MECHANICS.

MONKEY. A machine composed of a long pig of iron, traversing in a groove, which is raised by a pully and let fall suddenly on the head of large bolts, for driving them in where the weight of mauls would be insufficient; such, for instance, as the Deadwood-bolts, or the bolts that are driven in the Knee of the Head. This sort of Monkey generally has a frame with handles, with a groove on the under side; it slides upon a ridge of iron fixed in a bed, and is drawn backwards and forcibly forwards by a rope on each side.

MOOTING. Making a treenail exactly cylindrical to a given size or diameter called the *moot*. Hence, when so made, it is said to be *mooted*.

MORTISE. A hole or hollow made of a certain size and depth in a piece of timber, &c. in order to receive the end of another piece with a tenon fitted exactly to fill it.

MOTION. A continued and successive change of place. *See* VIS INERTIÆ.

If a body move *equally*, its motion is called *equable* or *uniform motion*. If it increases or decreases, it is called *accelerated* or *retarded motion*. When it is compared with some body at rest, it is called *absolute motion*. But, when compared with other bodies in motion, it is called *relative motion*.

The fundamental Axioms or LAWS OF MOTION, according to Sir Isaac Newton, are,

1. All Bodies continue their state of rest, or uniform motion, in a right line, till they are made to change that state by some external force impressed upon them.

2. The change of motion produced in any body, is always proportional to the force whereby it is effected; and in the same direction wherein the force acts.

3. Re-action is always contrary and equal to action; or, the actions of two bodies upon each other are equal, and in contrary direction.

4. Bodies mutually attract each other in proportion to their respective quantities of matter, and their attractions diminish in proportion as the square of the distance between them increases. *See* Mechanics. *See also* Gravity.

MOULDS. Pieces of deal or board made to the shape of the lines on the Mould Loft Floor, as the Timbers, Harpins, Ribbands, &c. for the purpose of cutting out the different pieces of timber, &c. for the ship. *(See Moulds, Plate* 1 *of Laying off.)* Also the thin flexible pieces of pear-tree or box, used in constructing the draughts and plans of ships, which are made in various shapes; viz. to the segments of circles from one foot to 22 feet radius, increasing six inches on each edge, and numerous elliptical curves, with other figures*.

MOULDED. Cut to the mould. Also the size or bigness of the timbers that way the mould is laid. *See* Sided.

MOULDING. The act of marking out the true shape of any timber from the mould. Also any ornamental projections, as the rails, finishings, &c.

MUNIONS or MUNTONS. The pieces that divide the lights in the stern and quarter galleries. *See Sheer Draught, Plate* 1.

NAILS. Iron pins of various descriptions for fastening board, plank, or iron work; viz. *Deck Nails*, or *Spike Nails*, which are from 4 inches and a half to 12 inches long, have snug heads, and are used for fastening planks and the flat of the decks. *Weight Nails* are similar to deck nails, but not so fine, have square heads, and are used for fastening cleats, &c. *Ribband Nails* are similar to weight nails, with this difference, that they have large round heads, so as to be more easily drawn. They are used for fastening the ribbands, &c. *Clamp Nails* are short stout nails, with large heads, for fastening iron clamps. Port Nails, double and single, are similar to clamp nails, and used for fastening iron work. *Rudder Nails* are also similar, but used chiefly for fastening the pintles and braces. *Filling Nails* are generally of cast iron, and driven very thick in the bottom planks instead of copper sheathing. *Sheathing Nails* are used to fasten wood sheathing on the ship's bottom, to preserve the plank, and prevent the filling nails from tearing it too much. *Nails of sorts* are 4, 6, 8, 10, 24, 30, and 40 penny nails, all of different lengths, and used for nailing board, &c. *Scupper Nails* are short nails, with very broad heads, used to nail the flaps of the scuppers. *Lead Nails* are small round-headed nails for nailing of lead. *Flat Nails* are small sharp-pointed nails, with flat thin heads, for nailing the scarphs of moulds. *Sheathing Nails* for nailing copper sheathing are of metal, cast in moulds, about one inch and a quarter long; the heads are flat on the upper side and countersunk below: the upper side is polished to obviate the adhesion of weeds. *Boat Nails*, used by Boat-builders, are of various lengths, generally rose-headed, square at the points, and made both of copper and iron.

NAVEL-HOODS. Broad pieces of oak, from 6 to 10 inches thick (according to the size of

* Moulds &c. of every sort requisite for Marine Drawing may be had of the Publisher of this Work.

the ship), worked afore the Hawse-holes on the outside of the ship, and likewise above and below them, in those ships which have no cheeks to support a bolster; the navel-hoods thus formed answering the same purpose.

NECKING. A small neat moulding at the foot of the taffarel over the lights. *See Stern, Plate* 1.

NEWELL. An upright piece of timber to receive the tenon of the rails that lead from the breastwork to the gangway.

NOG. A treenail projecting from the bottom of the ship as a stop to the heads of shores. Also a treenail driven through the heels of shores into the slip to secure them.

NOGGING. The act of securing the heels of the shores.

NORMAL. In Geometry, the same with a perpendicular; and used for a line or plane that intersects another perpendicularly.

NORMAN. A square fid of oak, or short carling, fixed through the head of the Rudder of East-India ships, to prevent the loss of the rudder in case of its being unshipt.

OAKUM. Old Rope, untwisted and loosened like hemp, in order to be used in caulking.

OBLIQUITY, ANGLE OF. *See* IMPULSION.

OBTUSE. Blunt or dull; in opposition to acute or sharp. As an *obtuse angle*, which is said to be without a square or right-angle. Such angles are called by shipwrights *Standing Bevellings*. *See* BEVELLINGS.

ORDINATES, or ORDINATE APPLICATES, in Geometry, are parallel lines, as represented in fig. 8, plate of Conic Sections, where PQ, FG, &c. terminating in a curve, and bisected by a diameter, as AP, are ordinates. The half of each of these, although commonly called an ordinate, is properly the semi-ordinate.

ORLOP. A temporary deck below the lower deck of large ships, chiefly for the convenience of stowing away the cables. There is also a platform in the midships of smaller ships, called the Orlop, and for the same purpose. *See Orlop Plan, Plate 5.*

OSCILLATION. *See* CENTRE of OSCILLATION.

OVERHANGING. Projecting over; as over the Stern, &c.

To OVER-LAUNCH. To run the butt of one plank to a certain distance beyond the next butt above or beneath it, in order to make stronger work.

OUT-BOARD. On the outside of the ship, as "the *Out-board Works*," &c.

OUTSQUARE. Any obtuse angle or standing bevelling is said to be "*outsquare*." This term is however mostly applied to knee-timber when the angle within the arms is greater than 45 degrees. *See* KNEE TIMBER.

OUT of WINDING Not twisting; as the surface of a timber or plank when it is a direct plane.

PALLETTING. A slight platform, made above the bottom of the Magazine, to keep the powder from moisture. *See Inboard Works and Magazine, Plates* 4 *and* 5.

PALLS. Stout pieces of iron, so placed near a capstan or windlass as to prevent a recoil, which would overpower the men at the bars when heaving. *See Capstan, Plate* 7.

PANEL. A square or pane of thin board, framed in a thicker one, called a stile, and generally composed of two or more joined together. Such are the partitions by which the officer's cabins are formed on the lower deck; and such likewise are the framings of the great cabin bulkheads, &c. which consist of rails, stiles, and panels.

PARABOLA. A figure arising from the section of a cone when cut by a plane parallel to one of its sides. *See* Conic Sections.

PARAMETER. *See* Conic Sections.

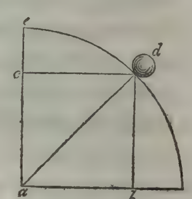
PARTNERS. Those pieces of thick plank, &c. fitted into a rabbet in the Mast or Capstan carlings for the purpose of wedging the mast and steadying the Capstan. Also any plank that is thick, or above the rest of the deck, for the purpose of steadying whatever passes through the deck, as the pumps, bowsprit, &c. *See Inboard Works, and Plans, Plates* 4, 5, *and* 6.

To PAY. To lay on a coat of tar, &c. with a mop or brush, in order to preserve the wood and keep out water. When one or more pieces are scarphed together, as the beams, &c. the inside of the scarphs are paid with tar as a preservative; and the seams after they are caulked are payed with pitch to keep the water from the oakum, &c.

PEDESTAL RAIL. A rail, about two inches thick, that is wrought over the foot-space rail, and in which there is a groove to steady the heels of the ballusters of the galleries. *See Stern, Plate* 1.

PERCUSSION. In mechanics, *percussion* is the impression a body makes in falling or striking upon another, or the shock of two bodies in motion.

Percussion is either direct or oblique; *direct*, when the impulse is given in a line perpendicular to the point of contact; and *oblique*, when it is given in a line oblique to the point of contact. *See* Centre.



The ratio which an oblique stroke bears to a perpendicular one, is as the sine of the angle of incidence to radius. Thus, let ab, in the margin, be the side of any body on which an oblique falls, with the direction da; draw dc at right angles to db, a perpendicular let fall from d to the body to be moved, and make de the radius of a circle; it is plain that the oblique force da, by the law of composition and resolution of motions, will be resolved into two forces dc and bd; of which dc being parallel to ab, hath no energy or force to move that body; and, consequently db expresses all the power of the stroke or impulse on the body to be moved; and, as db is the right sine of the angle of incidence dab, therefore the oblique force da is to one falling perpendicularly as the sine of the angle of incidence is to the radius.

PERIPHERY. The circumference or outward boundary of a circle, ellipsis, or any other regular curvilinear figure. *See Circle, Fig.* 2, *Plate A.*

PILASTERS. Flat columns or ornaments, prepared by the joiners, generally of deal, fluted or reeded, with moulded caps and bases, which are placed upon the munions of the ward-room lights, &c. for the purpose of ornamenting the stern and quarter galleries, particularly when the walk or balcony does not project aft. They are likewise used on the munions of the bulkheads of the captain's cabin and offices.

PILLARS. The square or turned pieces of timber erected perpendicularly under the middle of the beams for the support of the decks. *See Midship Sections, Plate* 8.

PINNACE. *See* BOATS.

PINS. Short iron rods fixed occasionally in the drum-heads of capstans, and through the ends of the bars, to prevent their unshipping. They are confined near their respective places by a chain. Others, of a larger size, are driven through the bitts to belay ropes to; and smaller ones are fixed in racks in different parts of the ship to belay the rigging to. The upright parts of the Bitts are also commonly called Bitt-Pins.

PINK. A ship with a very narrow round stern; whence all vessels, however small, having their sterns fashioned in this manner, are said to be *pink-sterned*.

PINS and PLATES. Pins occasionally drawn out to support the palls of the Capstan, and fitted in plates. *See Capstan, Plate* 7.

PINS of BOATS. Pins of iron or wood, fixed along the Gunwales of some boats, (instead of Rowlocks,) whose oars are confined by Grommets. *See figure of the Life Boat.*

PINTLES. Straps of mixt metal, or of iron, fastened on the rudder, in the same manner as the braces on the stern post, having a stout pin or hook at the ends, with the points downwards to enter in and rest upon the braces on which the rudder traverses or turns, as upon hinges, from side to side. Sometimes one or two are shorter than the rest, and work in a socket brace, whereby the rudder turns easier. The latter are called *Dumb-Pintles*. Some are bushed. *See Plates* 1, 10, *and* 14.

PITCH. Tar, boiled to a harder and more tenacious substance.

PITCHING. The inclination or vibration of the ship lengthwise about her centre of gravity; or the motion by which she plunges her head and after-part alternately into the hollow of the sea. This is a very dangerous motion, and when considerable, not only retards the ship's way, but endangers the masts and strains the vessel.

PLAN. The area or imaginary surface defined by or within any described lines. In ship-building, the *Plan of Elevation*, commonly called the SHEER-DRAUGHT, is a side-plan of the ship, defined by a surface limited by the head afore, by the stern abaft, the keel below, and the upper side of the vessel above. The *Horizontal Plan*, commonly called the HALF-BREADTH PLAN, comprehends all the lines describing the greatest breadth and length of the ship at different heights or sections. This is named Half-Breadth Plan, because both sides of the ship being exactly alike, only one-half is represented. To the foregoing must be added, the *Plan of Projection*, commonly called the BODY PLAN, which exhibits the outline of the principal timbers and the greatest heights and breadths of the same. *See the Plans, in Plates* 1, 5, *and* 6.

The PLAN of the TRANSOMS is the horizontal appearance of them, to which the moulds are made, and the bevellings taken. *See Plate 5 of Laying-off.*

PLANK. A general name for all timber, excepting fir, which is from one inch and a half to four inches thick. Of less dimensions it is called *Board*.

PLANKING. Covering the outside of the timbers with plank; sometimes quaintly called

Skinning, the plank being the outer coating, when the vessel is not sheathed. *See Planking, Plate* 3.

PLANK-SHEERS, or Plank-Sheer. The pieces of plank laid horizontally over the timber-heads of the Quarter-Deck, Forecastle, and Roundhouse, for the purpose of covering the top of the side, hence sometimes called Covering Boards. *See Sheer Draught, Plate* 1.

PLUMB. Perpendicular or upright. The term originates from *plumbum*, or lead, as the perpendicular is generally ascertained by a lump of lead suspended by a cord, and generally called a *Plumb-Line.*

PNEUMATICS. That science which teaches the properties of the air, or of its weight, pressure, and elasticity; and which ought, therefore, to be well known to every intelligent shipwright.

POINT-IRON or BRASS. A larger sort of Plumb, formed conically and terminating in a point, for the more nicely adjusting any thing, perpendicularly, to a given line.

POINT of CONTACT. The point in which one body, line, or figure, touches another.

POINT of SUSPENSION. The centre of any counteracting effort; as, in mechanics, that point in the axis or beam of a balance upon which it rests.

POINT-VELIQUE. That point where, in a direct course, the centre of effort of all the sails should be found. *See Steel's "Seamanship."*

POINTERS, or Braces. Timbers sometimes fixed diagonally across the Hold, to support the Beams, &c. *See Midship Sections, Plate* 8.

POOP. The uppermost deck of a ship abaft, commonly called the *Round-House. See Inboard Works, Plate* 4.

POPPETS. Those pieces (mostly fir) which are fixed perpendicularly between the ship's bottom and the bilgeways, at the fore and aftermost parts of the ship, to support her in launching. *See Frigate and Launch, Plate* 9.

PORT HOOKS. Iron hooks driven into the side of the ship, and to which the port-hinges are attached.

PORT-LIDS. The shutters, hung with hinges, which inclose the ports in rough weather.

PORTS. The square holes or openings in the side of the ship through which the guns are fired. *See Sheer Draught, Plate* 1.

POST. The same with *Stern Post.*

POWDER-ROOM. A convenient apartment, built abaft in large, and forward in small ships, with racks, &c. for holding Cartridges filled with powder. *See Inboard Works, Plate* 4.

PRESSURE of a FLUID. That force which is exerted by a fluid against, or for the support of, a solid body; as against the sides of a canal, of a ship, &c. *See* Impulsion.

The pressure of water, as this fluid is every where of the same density, is as its depth at any place, and in all directions the same, as we shall shew hereafter; and upon a square foot of surface every foot in height presses with a force of 1000 ounces, or $62\frac{1}{2}$ lb. avoirdupois.

PREVENTER-BOLTS. The bolts driven through the lower end of the preventer-plates, to assist the chain-bolts in heavy strains. *See Midship Sections, Plate* 8, *and Sheer Draught, Plate* 1.

PREVENTER-PLATES. Stout plates of iron, bolted through the sides at the lower part of the Chains, as an additional security. *See Midship Sections, Plate* 8, *and Sheer Draught, Plate* 1.

PRISM. A body or solid whose two ends are any plane figures which are parallel, equal, and similar; and its sides, connecting those ends, parallelograms.

PRIZING. Lifting or removing a heavy body by means of a lever.

PROFILE. The draught or scheme of the inboard works, which is usually described in red lines. *See Inboard Works, Plate* 4.

PROJECTION, PLAN OF, or Body Plan. *See* PLAN.

PRONG. The same as Beam-Arm. *See* BEAM-ARM.

PROOF TIMBER. An imaginary timber, expressed by vertical lines in the Sheer-Draught, similar to the joints of the square timbers, and used nearly forward and aft to prove the fairness of the body, *See Sheer Draught, Plate* 1.

PROW. A name very frequently given to the head or foremost end of a vessel, particularly by the French.

PUMP. The machine, fitted in the wells of ships, to draw water out of the Hold. *See Inboard Works, Plate* 4.

PUMP CISTERNS. Cisterns fixed over the heads of the pumps, to receive the water until it is conveyed through the sides of the ship by the Pump-dales. *See Plans, Plate 5.*

PUMP-DALES. Pipes fitted to the cisterns, to convey the water from them through the ship's sides. *See Plans, Plate 5.*

QUARTER. The upper part of the topside abaft. *See Sheer Draught, Plate* 1.

QUARTERING. Timber under five inches square.

QUARTER-DECK. That deck in ships of war which extends from the main-mast to the stern. *See Plans, Plate* 6.

QUARTER-GALLERIES. The projections from the Quarters abaft, fitted with sashes and ballusters, and intended both for convenience and ornament to the aft part of the ship. *See Sheer Draught and Stern, Plate* 1.

QUARTER-PIECES. Substantial pieces of timber, mostly of fir, that form the out-boundary of the stern, and connect the quarter-gallery to the stern and taffarel. *See Sheer Draught and Stern, Plate* 1.

QUARTER RAILS. Rails fixed into stantions from the stern to the gangway, and serving as a fence to prevent any one from falling overboard, &c. or birthing up the quarters. *See Sheer Draught, Plate* 1.

To QUICKEN. To give any thing a greater curve. For instance, "*To Quicken the Sheer,*" is to shorten the radius by which the curve is struck. This term is therefore opposed to straightening the sheer.

QUICKWORK. A denomination given to the strakes which shut in between the spirketting and clamps. *See Midship Sections, Plate* 8. By *Quickwork* is also sometimes meant, all that part of a ship or vessel which is below the level of the surface of the water when she is laden.

RABBET. A joint made by a groove, or channel, in a piece of timber cut for the purpose of receiving and securing the edge or ends of the planks, as the planks of the bottom into the keel, stem, or stern post, or the edge of one plank into another. *See Sheer Draught, Plate* 1.

RADIUS. The semi-diameter of a circle or a right line drawn from the centre to the circumference. *See Circle Fig.* 2, *Plate A.* In trigonometry, the Radius is termed the whole sine, or sine of 90 degrees.

RADII. The plural of *Radius.*

RAFT-PORT. A large square hole framed and cut through the buttock between the Transoms, or forward in the bow, between the breast-hooks, and through which Masts, Planks, Deals, &c. are taken into store-ships, or merchant-ships, carrying such cargoes which, owing to their great length, cannot be gotten on board in any other way.

RAG-BOLT. A sortof bolt having its point jagged or barbed to make it hold the more securely.

RAILS. The long narrow pieces of fir or oak, with mouldings struck on them, which are fastened, or sometimes wrought from the solid plank, as ornaments to the ship's sides, and also at the head and stern. The principal are as follow: The lower rail on the side, named the *Waist-rail;* and the next above it, the *Sheer-rail,* which are generally placed well with the sheer or top-timber line; the rails next above the Sheer-rail are called *Drift-rails,* and the rails above the plank-sheer the *Fife-rails.* The rails of the head are distinguished by the *Lower, Middle, Main,* and *Upper Rails;* and the rails of the stern take their names from the parts where they are fixed, as *Tuck-rail, Lower Counter-rail, Upper Counter-rail, Taffarel-rail,* and *Taffarel-Fife rail.* (*See Sheer Draught, Plate* 1.) To these may be added, the 'thwartship pieces of the framing of the great cabin bulkheads, &c.

RAKE. The overhanging of the stem or stern beyond a perpendicular with the keel, or any part or thing that forms an obtuse angle with the horizon.

RAKING-KNEES. *See* KNEE TIMBER.

RAM-LINE. A small rope or line sometimes used for the purpose of forming the sheer or hang of the decks, for setting the beams fair, &c.

RANGES. Horned pieces of oak, like belaying cleats, but much larger, bolted to the inside of the ship, in the waist, for belaying the Tacks and Sheets. Also those pieces of oak plank fixed between the ports, with semi-circular holes in them, for keeping shot in.

RASING. The act of marking by a mould on a piece of timber; or any marks made by a tool called a *rasing-knife.*

RATE. The denomination of the different classes of ships, according to their number of guns. Thus those of 100 guns and all above, are called *first-rates;* those of 98 and 90 guns, *second-rates;* from 80 to 64 guns, *third-rates;* from 60 to 50 guns, *fourth-rates;* from 40 to 32 are *fifth-rates;* and all under are *sixth-rates,* excepting Fire ships and Hospital ships, which are rated as fifth rates.

RAVE-HOOK. A hooked tool, used by Squaremakers, to haul out the small strips when enlarging the butts for receiving a sufficient quantity of oakum.

RECONCILER or RECONCILING SWEEP. A curve which reconciles the floor and lower-breadth sweeps together, and thus the shape of the body is formed below the breadth. *See* FRAMES.

To RECONCILE. To make one piece of work answer fair with the moulding or shape of the adjoining piece; and, more particularly, in the reversion of curves.

RECTILINEAR. In Geometry, right-lined; or consisting of strait lines.

REEMING. A term used by caulkers for opening the seams of the planks, that the oakum may be more readily admitted.

REEMING-IRONS. The large irons used by caulkers in opening the seams.

To RELIEVE. To make a sett near to another that cannot be sett on any more till it is taken in on each side. *See* SETT.

RENDS. Large open splits or shakes in timber; particularly in plank, occasioned by its being exposed to the wind and sun, &c.

RESISTANCE, or RESISTING FORCE. Any power which acts in an opposite direction, or which opposes another, so as to destroy or diminish its effects. Hence the force, by which bodies moving in fluid mediums are impeded or retarded, is denominated the *resistance* of those fluids. *See* IMPULSION. *See also the succeeding Chapter.*

RHODINGS OF THE PUMPS, &c. The brass cleats on which the axles work.

RIBBANDS. The longitudinal pieces of fir, about five inches square, nailed to the timbers of the square body (those of the same description in the Cant Body being shaped by a mould and called *Harpins)* to keep the body of the ship together, and in its proper shape, until the plank is brought on. The shores are placed beneath them. They are removed entirely when the planking comes on. The difference between *Cant Ribbands* and *Square* or *Horizontal Ribbands* is, that the latter are only ideal, and used in laying-off.

RIBBAND-LINES. The same with diagonal lines.

RIBS. A figurative expression for the timbers or frames of a ship, arising from the comparison of it with the human body, as the Keel with its Kelson to the back bone, and the timbers to the ribs. For the former unite and support the whole fabric, since the stem and stern frame, which are elevated on the ends of the keel, may be said to be a continuation of it, and serve to connect and inclose the extremities, by the hawse pieces and transoms, as the keel forms and unites the bottom by the floor-timbers. The idea carried further may in a manner represent the muscular parts of the human fabric; for the Wales, Clamps, and thickstuff, at the different heads of the timbers, are as so many muscles or strong ligaments to connect the ribs together, while the thinner planking may be compared to the skin or covering of the whole, and hence planking is often termed, *skinning* the ship. *See Midship Sections, Plate* 8.

RIDERS. Interior ribs, to strengthen and bind the parts of a ship together, being fayed upon the inside stuff, and bolted through all. They are mostly used in ships of war, and are variously situated, as the *Floor Riders,* which are fayed athwart the Kelson, and should be disposed upon the first futtocks of the ship. The next are the lower or *First Futtock Riders,* which fay alongside the floor-riders, and give scarph above them. These are completed by cross-chocks athwart their heels, that scarph to each side with hook and butt. The next are *Second Futtock Riders,* which fay alongside of the first futtock riders, down to the floor riders, and run up to the orlop beams. The *Third Futtock Riders* fay alongside the second futtock riders, scarph or meet the first futtock riders, and run up to the Gun-deck beams. The whole are bolted together fore and aft-wise. The Riders next above the foregoing are called *Breadth-Riders*, and are placed nearly in the broadest part of the ship, (hence their name,) and diagonally so as to partake of two or more timbers, the strength depending much thereon. Lastly, the *Top-Riders* are the uppermost; they stand nearly the same as breadth riders, and very much strengthen the top-side. *See Midship Bends, Plate* 8. Riders are not so much required in merchant ships as in ships of war, excepting floor and lower riders, (which are generally of iron,) because, in large ships the cargo being generally stowed low down, the upper works are not liable to strain and labour like those of ships of war laden high up with heavy metal.

RIMS. Those pieces which form the Quarter Galleries between the Stools. (*See Sheer Draught, Plate* 1.) Also a cast iron frame in which the dropping palls of a capstan traverses and brings up the capstan. *See Capstan, Plate* 7.

RING-BOLTS. *See* BOLTS.

RINGS. Circles of iron, or other metal, for lifting things by hand or securing the points of bolts, &c. *Hatch Rings* are those which are fixed to the hatches or scuttles, to open or shut them with. *Port-Rings* are those which are fixed to the port or scuttle lids to haul them open by, or bar them in.

RISING. A term derived from the shape of a ship's bottom in general, which gradually narrows or becomes sharper towards the stem and the stern-post. On this account it is that the Floor, towards the extremities of the ship, is raised or lifted above the keel: otherwise the shape would be so very acute, as not to be provided from timber with sufficient strength in the middle, or cutting-down. The floor timbers forward and abaft, with regard to their general form and arrangement, are therefore gradually lifted or raised upon a solid body of wood called the *dead* or *rising wood*, which must, of course, have more or less rising as the body of the ship assumes more or less fullness or capacity. *See* DEAD RISING.

The RISING of BOATS is a narrow strake of board fastened within side to support the thwarts. *See figure of the Life Boat.*

RISING HALF BREADTH, or NARROWING of the FLOOR SWEEP. A curve line, on the half-breadth plan, which determines the distance of the radius of the floor sweeps from the middle line. *See Sheer Draught, Plate* 1.

RISING FLOORS. The floors forward and abaft, which, on account of the rising of the body, are the most difficult to be obtained, as they must be deeper in the throat or at the cutting down to preserve strength.

RISING-LINE. An elliptical line, drawn on the plan of elevation, to determine the sweep of the floor-heads throughout the ship's length, which accordingly ascertains the shape of the bottom with regard to its being full or sharp. *See Sheer Draught, Plate* 1.

RISING-SQUARE. A square used in whole moulding, upon which is marked the height of the rising-line above the upper edge of the keel. *See Plate of the Long Boat.*

RISING-STRAIT, in whole moulding, is a curve line in the sheer plan, drawn at the inter section of the strait part of the bend mould, when continued to the middle line at each respective timber. *See Plate of the Long Boat.*

RISING-WOOD. *See* DEADWOOD.

ROLLERS. Cylindrical pieces of timber, revolving on an axis, and so fixed above the deck, either horizontally or perpendicularly, as to prevent the chafling of the cable or hawser, &c. against the jear and topsail sheet bitts, &c. Those placed forward in the manger are for the use of the voyal or messenger.

ROLLING. That motion by which a ship vibrates from side to side. Rolling is therefore a sort of revolution about an imaginary axis passing through the centre of gravity of the ship: so that the nearer the centre of gravity is to the keel, the more violent will be the roll; because the centre about which the vibrations are made is placed so low in the bottom, that the resistance made by the keel to the volume of water which it displaces in rolling, bears very little proportion to the force of the vibration above the centre of gravity, the radius of which extends as high as the mast-heads. But, if the centre of gravity is placed higher above the keel, the radius of the vibration will not only be diminished, but such an additional force to oppose the motion of rolling will be communicated to that part of the ship's bottom as may contribute to diminish this movement considerably.

It may be observed that, with respect to the formation of a ship's body, that shape which approaches nearest to a circle is the most liable to roll; as it is evident, that if this be agitated in the water, it will have nothing to restrain it; because the rolling or rotation about its centre displaces no more water than when it remains upright; and, hence, it becomes necessary to increase the depth of the keel, the rising of the floors, and the deadwood afore and abaft.

ROOMS. The different vacancies between the timbers, and likewise those between the beams, as the Mast-Rooms, Capstan-Room, Hatch-Room, &c. Also the different apartments or places of reserve, of which there are a number in a ship, as the *Bread-Room*, an apartment in the Hold abaft for containing the bread for the ship's use. The *Fish-room*, an apartment next adjoining, in which cured or dried fish was formerly stored, but which is now generally used as a coal-hole, and to stow spirits in. The *Captain's* and *Lieutenant's* Store-rooms, are two apartments built near each other on the starboard side of the after platform, for those officers to stow their wine in, &c. *Sail-Rooms* are built between decks upon the Orlop or lower deck to contain the spare sails. The *Spirit-Room* is built in the hold, next before the fish-room, to contain the spirituous liquors for the use of the ship's company. Besides these, there are several other store-rooms in which the Carpenter's, Boatswain's, and Gunner's stores are kept; with the *Steward's-Room*, whence most of the provisions are issued, and which is the place appointed for the Purser's Steward to transact his business in. *See Plans, Plate 5 and 6.*

The *Filling-Room* is a place parted off and lined with lead in the magazine, wherein the powder is started, in order to fill the cartridges.

ROOM and SPACE. The distance from the moulding edge of one timber to the moulding edge of the next timber, which is always equal to the breadth of two timbers, and two to four inches more. The Room and Space of all ships that have ports should be so disposed, that the scantling of the timber on each side of the lower ports, and the size of the ports fore and aft, may be equal to the distance of two rooms and spaces. *See Sheer Draught, Plate 1.*

ROUGH-TREE RAILS. Rails along the waist and quarters, nearly breast high, to prevent persons from falling overboard. This term originated from the practice in merchant vessels of carrying their rough or spare gear in crutch irons along their waist. *See Sheer Draught, Plate* 1.

ROUND-AFT. The segment of a circle that the stern partakes of from the Wing-transom upward.

ROUND-HOUSE. That part of the ship abaft, which is above the quarter-deck, fitted up with cabins, &c. for the accommodation of the officers. *See Inboard Works, Plate* 4.

ROUND-HOUSE, at the Head. Conveniences or seats of ease for the officers. *See Forecastle Plan, Plate* 6.

ROUND STERN. The stern of a vessel whose bottom, wales, &c. are wrought quite aft, and unite in the stern post. Few English vessels are built on this construction excepting small vessels, as Hoys, &c. *See* Square Sterned.

ROWLOCKS. The scores in the sides of boats wherein the oars or sculls are confined to row them with.

ROW PORTS. Square scuttles cut through the sides of frigates, sloops, and small vessels, one between each port in midships, through which the sweeps are worked to row them along in a calm or light wind. In point of utility they are therefore similar to row-locks along the gunwale of boats. *See Plates* 9 *and* 10.

ROUND-UP of the Transoms. The segment of a circle to which they are sided.

RUDDER or Rother. The machine, attached to the stern post, by the pintles and braces, which serves to direct the course of the ship. It is formed of several pieces of timber, of which the main piece is generally of oak, extends the whole length, and forms the head. The bearding piece, which forms the fore part, is of elm, and derives its name from its shape, because from the middle, each way, it is shaped angle-wise or bearded to two-fifths of its thickness, or less if the stern-post is bearded back, that the rudder occasionally may form an obtuse angle with the ship's length. The other pieces are of fir. *See Sheer Draught, Plate* 1.

RUDDER-CHOCKS. Large pieces of fir, to fay or fill up the excavation on the side of the rudder in the rudder hole; so that the helm being in midships the rudder may be fixed, and supposing the tiller broke another might thus be replaced.

RUDDER-IRONS. A name by which the pintles are frequently called. *See* Pintles.

RUDDER PENDANTS. Ropes to prevent the loss of the rudder in case of its being unshipped by accident.

RULES, Common and Sliding. The common rule used by shipwrights for measuring is the same as that used by carpenters in general, a two-feet jointed rule, divided into inches, quarters, and eighths. The Sliding Rule is likewise similar, but with a slide, graduated logarithmically, for shewing the result in cases of multiplication, &c. by inspection. The uses of this Rule are shewn hereafter.

RUN. The narrowing of the ship abaft, as of the floor towards the stern-post, where it becomes no broader than the post itself.

This term is also used to signify the running or drawing of a line on the ship, or mould loft floor, as " to *run* the wale line," or deck line, &c.

SADDLE. A piece sometimes fayed upon the upper end of the lacing to secure the foremost ends of the main rails.

SAGGING. *See* Hogging. In seamanship, Sagging *to leeward*, signifies the movement by which a ship makes considerable leeway, or is driven far to leeward of the course on which she apparently sails. It is generally expressed of heavy sailing vessels, as opposed to keeping well to windward, or "holding a good wind."

SAILS. The surfaces of canvas, extended on or between the masts, to receive the force of the wind, and thereby press the vessel through the water.

SAIL-ROOM. *See* Rooms.

SAMPSON's POST. A large pillar or stantion placed up diagonally on each side against the quarter-deck beam, and next afore the cabin bulkhead, with its lower end tenoned into a chase on the upper deck. It is used to bring the Fish-tackle too when fishing the anchor, &c. This name is also given to the pillar immediately under the hatchways, having scores on each side, as steps, to go up and down by. This pillar is of so much larger scantling than the other pillars, as not to be too much weakened by the scores.

SAWS. The most useful instruments used in carpentry. The *Hand-saw* is the smallest, and is used by one hand. The *Two-hand* or *Cross-cut Saw* is much longer, and is used by two men. The *Whip-saw* is the longest of all, being that generally used in a saw pit, or for the more laborious purposes. The *Hack-saw* is made of a scythe, jagged at the edge, and used chiefly, for cutting off iron bolts.

SCALE. The graduated lines, divided into equal parts, and placed at the bottom of the sheer draught, &c. as a common measure for ascertaining the dimensions by the plan; and for this purpose each of the larger divisions represents a foot, and the subdivisions inches. *See Sheer Draught, Plate* 1.

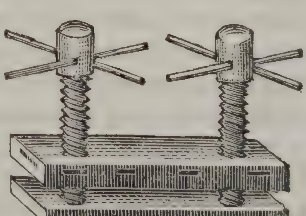
SCANTLING. The dimensions given for the timbers, plank, &c. Likewise all quartering under five inches square, which is termed Scantling; all above that size is called *Carling*.

SCARPHING. The letting of one piece of timber or plank into another with a lap, in such a manner, that both may appear as one solid and even surface, as keel-pieces, stem-pieces, clamps, &c.

'SCENDING. *See* Sending.

SCHOONER. A cutter-built vessel, but longer in proportion than a cutter, and having two masts whose main sail and fore sail are spread upon a gaff or boom.

SCREEN BULKHEAD. The after bulkhead under the Roundhouse. *See Inboard Works, Plate* 4, *and Plans, Plate* 6.



SCREWS, Bed or Barrel. A powerful machine for lifting large bodies; and, when placed against the gripe of a ship to be launched, for starting her. It consists of two large poppets or male screws, having holes through their heads to admit levers, a bed formed by a large oblong piece of elm, with female screws near each end to admit the poppets, and a sole of elm plank for the heels of the poppets to work on, agreeably to the annexed figure. Those used as last described, have an inclined sole so as to stand square to the stem or knee.

SCREWS, HAND. *See* Hand Screws.

SCROLL. A spiral ornament fastened at the drifts. *See* Drifts. Likewise the finish of the upper part of the Hair Bracket. *See Sheer Draught, Plate* 1. For Scroll Head, see Head.

SCUPPERS. Lead pipes let through the ship's side to convey the water from the decks.

SCUTTLES. Square openings cut through the decks, much less than the hatchways, for the purpose of handing small things up from deck to deck. There are also Scuttles cut through the sides of the ship, some for the admission of air and light into the cabins between decks, and some between the ports, through which the sweeps are used, to row the ship along in calms. *See Plans, Plates 5 and* 6.

SEA BOAT. A vessel that bears the sea firmly, without straining her masts, &c. is commonly said to be "a good *sea-boat.*"

SEAMS. The openings between the edges of the planks when wrought.

SEASONING. A term applied to a ship kept standing a certain time after she is completely framed and dubbed out for planking, which should never be less than six months when circumstances will permit. *Seasoned Plank or Timber* is such as has been cut down and sawn out one season at least, particularly when thoroughly dry, and not liable to shrink.

SEAT. The scarph or part trimmed out for a chock, &c. to fay to.

SEATING. That part of the floor which fays on the dead-wood; and of a transom which fays against the post.

SEAT TRANSOM. That transom which is fayed and bolted to the counter-timbers, next above the deck transom, at the height of the port sills. *See Inboard Works, Plate* 4.

SECTION. A draught or figure, representing the internal parts of the ship, at any particular place athwartships. *See Midship Sections, Plate* 8.

SENDING or Scending. The act of pitching violently into the hollows or intervals of the waves.

SETTING or SETTING-TO. The act of making the planks, &c. fay close to the timbers, by driving wedges between the plank, &c. and a wrain-staff. Hence we say, "set or set away," meaning to exert more strength. The power or engine used for the purpose of setting is called a Sett, and is composed of two ring-bolts, and a wrain-staff, cleats, and lashings.

SHACKLES. The small ring-bolts driven into the ports, or scuttles, and through which the lashing passes when the ports are barred in.

SHAKEN or SHAKY. A natural defect in plank or timber when it is full of splits or clefts and will not bear fastening or caulking.

SHANK-PAINTER. A chain bolted through the topside, abaft the cathead, to retain the shank and flukes of the anchor when stowed.

SHEATHING. A thin sort of doubling, or casing, of fir-board or sheet copper, and sometimes of both, over the ship's bottom, to protect the planks from worms, &c. Tar and hair, or brown paper dipt in tar and oil, is laid between the sheathing and the bottom.

SHEAVE. A cylindrical wheel, made of hard wood, moveable round a pin at its axis, and placed in a block, of which there are several in the sides of a ship, let through the side and chest-trees, for assisting to lead the tacks and sheets on board, &c.

SHELL-ROOMS. A compartment in a bomb-vessel, fitted up with shelves to receive bomb-shells when charged.

SHEER. The longitudinal curve or hanging of the ship's side in a fore and aft direction. *See Sheer Draught, Plate* 1.

SHEER-DRAUGHT. The plan of elevation of a ship, whereon is described the outboard works, as the wales, sheer-rails, ports, drifts, head, quarters, post, and stem, &c. the hang of each deck inside, the height of the water lines, &c. *See Sheer Draught, Plate* 1.

SHEER-RAILS. The narrow ornamental mouldings along the topside, which are parallel to the sheer. They are generally made of deal, but are sometimes wrought from the solid plank. *See Sheer Draught, Plate* 1.

SHEER-STRAKE. The strake or strakes wrought in the topside, of which the upper edge is wrought well with the toptimber line, or top of the side, and the lower edge kept well with the upper part of the upper deck ports in midships, so as to be continued whole all fore and aft, and not cut by the ports. It forms the chief strength of the upper part of the topside, and is therefore always worked thicker than the other strakes, and scarphed with Hook and Butt between the drifts. *See Sheer Draught, Plate* 1.

SHEER-WALES, or MIDDLE-WALES. Those strakes of thick stuff in the topside of three-decked ships which are wrought between the middle and lower deck ports.

SHEERS. Two rough masts erected across the building slip, for hoisting the ship's frames, &c. They are lashed together at their upper ends, with tackles depending from the intersection at top; and are kept upright by guys extending forward and aft from the heads. The heels are lashed to prevent their spreading.

That some judgment may be formed of the dimensions of sheers, we subjoin the following, which are sufficient for raising the stern-frame of the largest ship in the English navy. Two masts, each 19½ inches in diameter, and 66 feet long; spread at the heels, from out to outside, 46 feet 4 inches. The tackles consisting of four treble blocks, 28 inches long, the sheaves brass coaked. The Falls new eight-inch rope. One treble block lashed, so as to be fixed to the aft part of the sheers, and another to the foreside. Shivers to stand nearly athwartships, and fair with the leading block at the heel of the sheers, to prevent the fall from rubbing against the cheeks of the blocks. One treble block lashed to the back of the stern-frame, between the deck and filling transoms, to stand athwartships, and lead to the opposite sheer. To have a double tackle at the head of the stern-post, the fall 3½ inch rope, to bowse the head forward occasionally, with a double tackle at the heel of 4½ inch rope, to ease it forward or bowse it aft as required. One double tackle at each end of the wing-transom (called Horning Tackles) to lead to the standards most convenient to horn or square the frame as wanted. The after treble block at the sheer-head is to plumb the after part of the wing-transom as nearly as possible; and the guys to steady the sheer-heads, two to lead forward and two aft on each side of the slip, to be 7 inch hawsers.

SHIFT. A term applied to disposing the butts of the planks, &c. so that they may over-launch each other without reducing the length, and so as to gain the most strength. The planks of the bottom, in British-built ships of war, have a six feet shift, with three planks between each butt, so that the planks run 24 feet long. In the bottoms of merchant ships they have a six feet shift, with only two planks between each butt, making but 18 feet planks in length. The shift of the timbers are more or less according to the contract. *See Disposition of the Frame, Plate 2, and Planking, Plate* 3.

SHIFTING. The act of setting off the length of the planks in the bottom, topside, &c. that the butts may over-run each other, in order to make a good shift. *(See Planking, Plate 3.)* Replacing old stuff with new is also called *Shifting*.

SHOLES. Pieces of oak or plank, placed under the soles of the standards *(See Midship Sections, Plate* 8.*)*; or under the heels of shores, in docks where there are no groundways, to enable them to sustain the weight required without sinking. Old hanging port-lids are particularly suitable and useful for this purpose.

SHORES Those pieces of timber fixed under the ribbands or against the sides and bottom of the ship to prop her up whilst building.

SHOT LOCKERS, or GARLANDS. Apartments built up in the Hold to contain the shot. *(See Inboard Works, Plate* 4, *and Plans, Plate* 5.*)* Also pieces of oak plank, fixed against the head ledges and coamings of the hatch and ladderways, or against the side between the ports, to contain the shot; for which purpose they are hollowed out to near one third of its diameter, so that the balls lie in them about one inch asunder.

SHRINKING. The contraction or loss of substance in timber as it gets dry.

SHROUDS. The range of large ropes extended from each side of the ship to the mast-heads for the support of the masts.

SIDE COUNTER TIMBER. The stern timber which partakes of the shape of the topside, and heels upon the end of the wing transom. *See Disposition, Plate* 2.

SIDING or SIDED. The size or dimensions of timber the contrary way to the moulding, or moulded side.

SILLS or CELLS. The pieces of plank, or timber, let in horizontally between the frames, to form the lower and upper sides of the ports, and between the timbers for scuttles, &c. *See Disposition of the Frame, Plate* 2.

SINE, or Right Sine *of an* Arch. A right line drawn from one end of that arch, perpendicular to a radius drawn to the other end of the arch; and being always equal to half the chord of twice the arch. *See Circle, &c. fig.* 2, *Plate* A.

The Co-Sine, or sine of the complement of an arch, is the sine of what the given arch wants of 90 degrees.

The radius is called the *whole sine*, or the sine of 90 degrees.

The Versed-Sine of an arch is the part intercepted between the right sine and the extremity of the arch. By an inspection of the figure it will appear that the versed sine of 60° and the co-sine of 60° are equal.

SIRMARKS. The different places marked upon the moulds where the respective bevellings are to be applied, as the lower sirmark, floor sirmark, &c. *See Moulds, Plate* 1 *of Laying off.*

SKEG. The after part of the keel, or that part whereon the stern-post is fixed.

SKEG-SHORES. One or two pieces of four-inch plank, put up endways under the keg of the ship, to steady the after part a little when in the act of launching. They are confined to the bottom of the slip by a hinge. The upper part is rounded, and they should be so carefully fixed as to fall readily when the ship starts; for the writer hereof once saw a seventy-four gun ship detained from launching by her skeg-shores only.

SKIDS. Pieces of plank, formed to the topside of the ship, and extending vertically from the wales to the top of the side. Their use is, to preserve the ship's side from being injured by weighty bodies, when hoisted into or lowered out of the ship; but, as they are seldom wanted, for the reason heretofore given under the article Fenders, their tendency to assist in rotting the sides ought to explode them.

SKINNING. A term often used for Planking. *See* RIBS.

SLEEPERS. Pieces of compass timber fayed and bolted upon the transoms and timbers adjoining, withinside, to strengthen the buttock of the ship.

SLICES. Tapering pieces of plank, used to drive under the false keel, and settle the ship upon.

SLIDING KEELS. An invention of the ingenious Captain Schank, of the Royal Navy, to prevent vessels from being driven to leeward by a side wind. They are composed of plank of various widths, erected vertically, so as to slide up and down, through the keel, and are constructed as described hereafter. *See Plate of the Cutter.*

SLIDING PLANKS are the planks upon which the Bilgeways slide in Launching. *See* 44 *Gun Ship and Launch, Plate* 9.

SLIP. The foundation laid for the purpose of building the ship upon, and launching her.

SLOOP. According to the general acceptation of the word, a small merchant or coasting vessel with one mast. But all ships of the Royal Navy carrying less than twenty guns, and being above the class of gun-vessels, are denominated sloops, excepting bomb-vessels and fire-ships. *See Sloop of War, Plate* 10.

SLOP-ROOM. The place appointed for the Purser to keep the ship's slops in. *See* ROOM, *and Orlop Plan, Plate* 5.

To SNAPE. To hance or bevel the end of any thing so as to fay upon an inclined plane.

SNOW. A vessel similar in construction to a Brig, but the largest of vessels fitted with two masts. It has a square foresail and mainsail, with a trysail abaft, resembling the mizen of a ship, and hoisted by a gaff upon a small mast, close abaft the main mast, which is called the trysail mast.

SNYING. A term applied to planks when their edges round or curve upwards. The great sny occasioned in full bows or buttocks is only to be prevented by introducing Steelers. *See* STEELERS.

SOLE. A sort of lining to prevent wearing or tearing away the main part to which it may be attached; as to the Rudder, Bilgeways, &c. *See Frigate and Launch, Plate* 9, *and Sheer Draught, Plate* 1.

SPALING. Keeping the frames of a ship to their proper breadths by the cross-spales, which should so remain till some of the deck knees are bolted. *See* Cross Spales.

SPANSHACKLE. A large bolt driven through the forecastle and upper deck beams, and forelocked under each beam. It has a large square ring at the head, for the purpose of receiving the end of the davit. It has however been long since disused in the Royal Navy, as the Davits are more commodiously fixed in the fore-channels.

SPARS. Small firs used in making Staging.

SPECIFIC GRAVITY. The comparative difference in the weight or gravity of two bodies of equal bulk; hence called also, relative or comparative gravity, because we judge of it by comparing one body with another.

If bodies be equal in bulk, it is evident that their specific gravities may be easily obtained by a common balance; and hence fluids, or any bodies that may be easily reduced to the same bulk or form, may be easily weighed and compared.

The specific gravity of bodies which are not, nor can easily be, reduced to an equal bulk, is not to be obtained by any method equally obvious to unphilosophical persons. A method however has been invented for determining the specific gravities of solid bodies, whatever their figure or dimensions; for, as it is an obvious principle, that every body immersed in a fluid must displace a quantity of the fluid equal to its own bulk, and the resistance which it meets with from the fluid will be found exactly equivalent to the weight of the fluid displaced; hence, if any fluid, as water, for instance, be taken as the standard of comparison, it will be easy to determine the specific gravity of different solids, by weighing them first accurately in air, and afterwards weighing them in water, and comparing their loss of weight in the latter fluid, which will be in exact proportion to the space which they occupy.

To elucidate this by experiment: Suppose the specific gravities of any two metals were to be determined, say lead and tin, for instance. Take a certain quantity of lead, and weighing it carefully in air, I find its weight amounts to thirty-four ounces; on weighing it again in water, I find it weighs but thirty-one ounces; that is, it has lost three ounces of its weight: or, in other words, the same bulk of water would weigh three ounces; the specific gravity of lead is therefore to that of water as 34 to 3, or as $11\frac{1}{3}$ to 1.

Again, upon weighing a certain quantity of tin, we find its weight to be fifteen ounces, and on weighing it in water, it appears to have lost two ounces of that weight: the specific gravity of tin, therefore, to that of water, is as 15 to 2, or as $7\frac{1}{2}$ to 1; consequently, the comparative gravities of the two metals are as $11\frac{1}{3}$ to $7\frac{1}{2}$ *.

In the following table of specific gravities, the numbers express the number of avoirdupois ounces in a cubic foot of each body; that of common or rain water being just 1000 ounces. To determine, therefore, the specific gravity of any substance heavier than water, weigh any given quantity of that substance in air, in a common balance, and afterwards weigh it in water, carefully noting its loss of weight; divide its whole absolute gravity, or weight of the substance in air by it loss of weight in water, and you will have its true specific gravity.

* See Nicholson's Philosophy, Vol. II. page 11.

A TABLE OF SPECIFIC GRAVITIES.

Lead	11325	Ebony	1177	Rain Water	1000
Fine Copper	9000	Pitch	1150	Oak	925
Gun Metal	8784	Rosin	1100	Ash	800
Fine Brass	8350	Mahogany	1063	Beech	700
Iron from 7827 to	7645	Box Wood	1030	Elm	600
Cast Iron	7425	Sea Water	1030	Fir	548
Sand	1520	Tar	1015	Cork	240
Lignum Vitæ	1327	River Water	1009	Common Air	1,232

These numbers being the weight of a cubic foot, or 1728 cubic inches, of each of the bodies in avoirdupois ounces; by proportion, the quantity in any other weight, or the weight of any other quantity, may be readily known.

For Example. Required the content of an irregular piece of oak, which weighs 76lbs. or 1216 ounces.

Here as 925 (Sp.gr.oz.) : 1216 (wt.oz.) :: 1728 (cub.in.) : 2271 (cub.in.) = 1 ft. 543 inches cubic, the content.

Example 2. To find the weight of a log of mahogany, 20 feet long, by 2 feet square. Here $20 \times 2 \times 2 = 80$.

Therefore as 1 ft : 80 ft :: 1063 oz : 85040 oz. or 2 tons and 1315lbs. the weight of the log.

SPHERE. A solid contained under one uniform round surface, such as would be formed by the revolution of a circle about its diameter as an axis.

The solid content of a sphere or globe is to the cube of its diameter as 0,5235988 to 1, or unity; and the proportion of its surface is to the area of a section through its diameter, as the circumference of a circle is to its diameter. *See* CIRCLE.

SPHEROID. A solid approaching to the figure of a sphere, and of which the figure is generated by the entire revolution of a semi-ellipsis about its axis.

SPILES. Small wooden pins, which are driven into nail-holes, to prevent leaking, &c.

SPILINGS. The dimensions taken from a straight line, a mould's edge, or rule-staff, to any given line or edge. *See Moulds, Plate* 1 *of Laying-off.*

SPIRIT ROOM. A place built abaft the after hold to contain the spirits. *See* ROOMS.

SPIRKETTING. A thick strake, or strakes, wrought within side upon the ends of the beams or waterways. In ships that have ports the spirketting reaches from the waterways to the upper side of the lower sill, which is generally of two strakes, wrought anchor-stock fashion; in this case, the planks should always be such as will work as broad as possible, admitting the butts be about six inches broad. *See Midship Sections, Plate* 8.

SPLA-BOARDS. Boards or plank fixed to an obtuse angle, to throw the light into the filling room of a magazine. *See Orlop, Plate* 5.

SPRUNG. A term indicating that a plank, &c. is strained so much in the working as to crack or fly open, and so as to be nearly broken off. To SPRING, is to quicken or raise the sheer.

SPURN WATER. A channel left above the ends of a deck to prevent water from coming any farther.

SPURS. Large pieces of timber, the lower ends of which are fixed to the bilgeways, and the upper ends fayed and bolted to the ship's bottom. They are used in some of the Royal Yards, although not by merchant builders, as an additional security to the bilgeways in case any other part should fail in launching the ship.

SPURS of the BEAMS, or Beam Arm. *See* Beam-Arm.

A SQUARE. An instrument formed by a stock and a tongue, fixed at right angles. To Square is to horn or form with right angles; and to Stand-Square is to stand or be at right angles relatively to some object.

SQUARE BODY. The figure which comprehends all the timbers whose areas or planes are perpendicular to the keel, which is all that portion of a ship between the cant-bodies. *See* Bodies.

A SQUARE MAKER. A shipwright who cuts the butts to receive the oakum, and prepares the work ready for the caulkers.

SQUARE RIBBANDS. The same as horizontal ribbands. *See* Ribbands.

SQUARE-STERNED. A term applied to ships whose wing-transom is at right angles, or nearly at right angles, with the stern-post, and towards the upper sides of which the upper planks of the bottom butt, or finish, in a rabbet formed by the tuck rail; the other part of the plank stopping at the side counter timbers, by which means the stern may be commodiously fitted with sashes, walks, &c. All British ships are now built upon this principle, whilst many of other nations are still constructed by the ancient methods; hence we so frequently hear the phrase of "Square-sterned and British built," as our practice in this respect justly claims the superiority over that of all other nations.

SQUARE TIMBERS. The timbers which stand square with, or perpendicular to, the keel. *See* Square body.

SQUARE TUCK. A name given to the after part of a ship's bottom when terminated in the same direction up and down as the wing-transom, and the planks of the bottom end in a rabbet at the foreside of the fashion-piece; whereas ships with a buttock are round or circular, and the planks of the bottom end upon the wing-transom. *See Yacht, Plate* 11, *and Plate* 6 *of Laying-off.*

STABILITY. That quality which enables a ship to keep herself steadily in the water, without rolling or pitching. Stability, in the construction of a ship, is only to be acquired, by fixing the centre of gravity at a certain distance below the meta-centre; because the stability of the vessel increases with the altitude of the meta-centre above the centre of gravity. But, when the meta-centre coincides with the centre of gravity, the vessel has no tendency whatever to remove out of the situation into which it may be put. Thus, if the vessel be inclined either to the starboard or larboard side, it will remain in that position till a new force is impressed upon it: in this case, therefore, the vessel would not be able to carry sail, and is consequently unfit for the purposes of navigation. If the meta-centre falls below the common centre of gravity, the vessel will immediately overset.

As the meta-centre, or its determination, is of the utmost importance in the construction of ships, this subject is more particularly illustrated hereafter.

STAGES. The platforms on which the shipwrights work.

STANDARDS. Large knees, of oak or iron, fayed on the deck and against the side. The arm upon the deck is bolted through the beams and clenched beneath, and the other arm through the ship's side. Their use is, for strengthening the sides, and for resisting any violent or sudden shock. *See Midship Sections, Plate* 8.

There is also a standard fayed on the gun-deck against the apron forward, another against the transoms abaft, and one in the head upon the knee, when the piece against the stem does not run high enough for the hole of the main-stay collar. *See Inboard Works, Plate* 4.

STANDARDS are also large poles, set up endways, at certain distances round the slips, and to which the spars are hung to support the staging. They have cleats nailed along the fore and after sides, at about two feet distance, in nearly the whole length.

STANDING. A term applied to a bevelling which is obtuse, or without a square, to distinguish it from an acute or under bevelling, which is within a square. *See Circle, Fig.* 2. *Plate A.*

STANTIONS or STANTIENTS. The upright pieces of quartering in a bulkhead, breastwork, &c. Likewise the iron uprights, fixed round the quarters for the netting, and along the waist, to ship the rail in, &c.

STAPLES. Crooked fastenings generally made of copper, from six to twelve inches long, with a jagged hook at each end. They are driven into the sides of main and false keels, to fasten them.

STARBOARD-SIDE. The right-hand side of the ship when looking forward from the stern.

STAYS. Large ropes to support the masts which are extended towards the fore part of the ship counteracting the effort of the shrouds which mostly lead abaft, and thereby keeping the mast in one steady position.

STEELER. A name given to the foremost or aftermost plank, in a strake which drops short of the stem and stern post, and of which the end or butt nearest the rabbet is worked very narrow and well forward or aft. Their use is, to take out the snying edge occasioned by a full bow, or sudden circular buttock. *See Planking Expanded, Plate* 3.

STEERING-WHEEL. The wheel on the quarter deck to which the tiller rope is connected; and, by the turning of which, the helm is moved or kept in any fixed position. *See Inboard Works, Plate* 4.

STEM. The main timber at the fore part of the ship, formed, by the combination of several pieces, into a circular shape, and erected vertically to receive the ends of the bow-planks, which are united to it by means of a rabbet. Its lower end scarphs or boxes into the keel, through which the rabbet is also carried, and the bottom unites in the same manner. *See* RIBS. *See Sheer Draught, Plate* 1.

STEMSON. A piece of compass timber, wrought on the aft part of the apron withinside, the lower end of which scarphs into the kelson. Its upper end is continued as high as the middle or upper deck; and its use is to succour the scarphs of the apron, as that does those of the stem. *See Inboard Works, Plate* 4.

STEPPING. A rabbet sunk in the dead-wood, at the bearding line, whereon the heels of the timbers rest. *See* Bearding Line. *See also Sheer Draught, Plate* 1.

STEPS of the Masts. The steps into which the heels of the masts are fixed, are large pieces of timber. Those for the main and fore masts are fixed across the kelson, and that for the mizen mast upon the lower deck beams. The holes or mortises into which the masts step, should have sufficient wood on each side, to accord in strength with the tenon left at the heel of the mast, and the hole should be cut rather less than the tenon, as an allowance for shrinking. *See Inboard Works, Plate* 4.

STEPS for the Capstan. Solid lumps of oak, fixed on the beams, in which the heels of the capstans work. *See Inboard Works, Plate* 4.

STEPS for the Ship's side. The pieces of quartering, with mouldings, nailed to the sides amidships, about nine inches asunder, from the wale upwards, for the convenience of persons getting on board. *See Sheer Draught, Plate* 1.

STERN. The after part of the ship, extending from the wing transom upwards, being terminated above by the taffarel, below by the counters, and on the sides by the quarter-pieces. It therefore comprehends the lights or windows of the Captain's cabin, &c. *See Sheer Draught, Plate* 1.

STERN FRAME. The strong frame of timber, composed of the stern-post, transoms, and fashion-pieces, which form the basis of the whole stern. *See Plate 5 of Laying-off.*

STERN-POST. The principal piece of timber in the stern frame, on which the rudder is hung, and to which the transoms are bolted. It therefore terminates the ship below the wing-transom, and its lower end is tenoned into the keel. *See Sheer Draught, Plate* 1.

STEWARD'S ROOM. An apartment built on the larboard side of the after platform, whence the purser's steward issues the provisions to the ship's company, and where he makes up his accounts, &c. *See Plans, Plate* 5.

STIFF. Stable or steady. *See* Stability.

STILES. The upright pieces of the framing of the great cabin bulkheads, &c. which comprehend the panels.

STIRRUP. An iron or copper plate, that turns upwards on each side of a ship's keel and deadwood, at the fore-foot, or at her skeg, and bolts through all. This can only be necessary when the deadwood-bolts are driven short, or are supposed to be insufficient.

STIVING. The elevation of a ship's cathead or bowsprit; or the angle which either makes with the horizon. *See Sheer Draught, Plate* 1.

STOOLS. Pieces of plank, bolted to the quarters, for the purpose of forming and erecting the galleries. *(See Sheer Draught, Plate* 1.*)* Also ornamental blocks for the poop lanterns to stand on abaft. *See Sloop, Plate* 10. *See also* Backstay Stools.

STOPPINGS-UP. The poppets, timber, &c. used to fill up the vacancy between the upper side of the bilgeways and the ship's bottom, for supporting her when launching. *See Launch, Plate* 9.

STOPPER-BOLTS. Large ring-bolts, driven through the deck and beams before the main-hatch, for the use of the stoppers. They are carefully clenched on iron plates beneath. *See Gun-deck Plan, Plate 5.*

STOPPERS. Short ropes, with a knot at one end, and the other end turned round a thimble into the ring of the stopper-bolts, by which, and its laniard, the cable is confined.

STORE-ROOMS. The several apartments built upon the platform to contain the different officer's stores. *See* ROOMS. *See also Plans, Plate 5.*

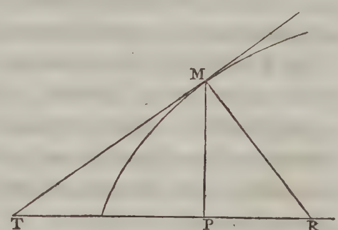
STRAIGHT of BREADTH. The space before and abaft dead-flat, in which the ship is of the same uniform breadth, or of the same breadth as at ⊕ or dead-flat. *See* DEAD-FLAT.

STRAKE. One breadth of plank wrought from one end of the ship to the other, either within or without board.

A STREAM. A quantity of fluid, having all its particles moving in one direction, and in parallel lines. The breadth of the stream is considered as a line perpendicular to all these parallels. *See* BASE.

A FILAMENT is an imaginary portion of a stream, of very small breadth, consisting of a row of corpuscles, or of an indefinite number of particles, following each other in the same direction, so as successively to impinge on, or glide along, the surface of a solid body.

STRING. One or two planks withinside, next under the gunwale, answering to the sheer-strake withoutside, scarphed in the same manner as the sheer-strake, giving shift to the scarphs of the sheer-strake, and bolted through the ship's side into the sheer-strake between the drifts, to give greater strength; as this part requires all the security that is possible to be given, in order to assist the sheer. *See Midship Sections, Plate 8.*



SUB-NORMAL. A line which determines the position in the axis of a curve, where a normal, or perpendicular, raised from the point of contact of a tangent to the curve, cuts the axis. Or, the sub-normal is a line which determines the point wherein the axis is cut by a line falling perpendicularly on the tangent in the point of contact. Thus TM, being a tangent to a curve in M, and MR a normal or perpendicular to the tangent, the line PR, intercepted between the semi-ordinate PM and the normal MR, is called the *sub-normal.* Hence, in a parabola, the sub-normal PR is to the semi-ordinate PM, as PM is to PT, and MR to TM. 2, In the parabola the sub-normal PR is subduple of the parameter; and, consequently, an invariable quantity.

SUPERNATANT PART OF THE SHIP. That part which when afloat, is above the water: Anciently expressed by the name of *Dead Work.*

SUPPORTERS. The circular knees placed under the catheads for their security and support. *See Sheer Draught, Plate 1.*

SURGE. The tapered part of the whelps, between the chocks of the capstan, upon which, when judiciously hollowed, the messenger may surge itself without any other incumbrance. *See Capstan, Plate 7.*

SURMARKS. *See* SIRMARKS.

SWEEP OF THE TILLER. A semi-circular plank, fixed up under the beams near the fore end of the tiller, which it supports.

On the foreside of the sweep is a groove for the tiller rope, in which groove rollers are fixed to enliven the rope. On the aftside is a ledge or rabbet defended with iron plate, on which the goose-neck of the tiller traverses. *See Plan of the Upper Deck, Plate* 6.

SWEEPS. The various parts of the bodies shaped by segments of circles. Such are the *Floor Sweeps, Lower Breadth Sweep, Upper Breadth Sweep,* and *Back Sweep,* or *Toptimber Hollow. See* FRAMES. *See also Body Plan, Plate* 1.

SYPHERED. A mode of joining, by over-lapping the edge of one plank upon another, with a bevelling edge, instead of rabbetting, in such a manner that both planks shall make a plain surface, though not a flat or square joint. *See* HARRIS-CUT.

TABLING. Letting one piece of timber into another by alternate scores or projections from the middle, so that it cannot be drawn asunder either lengthwise or sidewise. *See Beams of Gun-deck Plan, Plate 5.*

TACKLE. An assemblage of two or more blocks, connected by a rope called the Fall, reeved through their mortises, and used for lifting or removing weighty bodies.

TAFFAREL, or TAFF-RAIL. The upper part of the ship's stern, usually ornamented with carved work or mouldings, the ends of which unite to the quarter-pieces. *See Sheer Draught, Plate* 1.

To TAIL, or DOVE-TAIL. To let one piece of timber into another, when the lap forms a sort of wedge, so that it cannot come asunder endways. *See Sloop's Stern, Plate* 10.

To TAKE-IN. To come up with a sett and make it fast again closer to the plank, as it works nearer to the Timbers. *See* SETT.

TANGENT. The tangent of a circular arch is a right line, raised perpendicularly on the extreme of the diameter, and continued to a point where it is cut by a secant, that is, by a line drawn from the centre through the extremity of the arch, whereof it is a tangent. *See Circle, Figure* 2. *Plate A.*

The tangent of a curve, or tangential line, is a right line which only touches the curve in one point but does not cut it.

TAR. The juices of the Pine or Fir-tree boiled to a thick consistence, and used to pay the joints between scarphs of beams, &c. and also the outside of the ship; as tar, by filling up the pores of the wood, prevents the sun from splitting, and the wet from rotting it.

TASTING of PLANK or TIMBER. Chipping it with an adze, or boring it with a small auger, for the purpose of ascertaining its quality or defects.

TO TEACH. A term applied to the direction that any line, &c. seems to point out. Thus we say "let the line or mould *teach fair* to such a spot, rase, &c."

TENON. The square part at the end of one piece of timber diminished so as to fix in a hole of another piece, called a mortise, for joining or fastening the two pieces together.

TERMS or TERM PIECES. Pieces of carved work placed under each end of the taffarel, upon the side stern-timber, and reaching as low down as the foot-rail of the balcony.

THWARTS. The benches in a boat whereon the rowers sit to manage their oars.

THOLES. The battens or pins which form the rowlocks of a boat.

TIER. A regular row of any thing, as of carlings, of shores, of ships, &c. *See Gun-deck Plan, Plate 5.*

THICKSTUFF. A name for sided timber, exceeding four inches, but not being more than twelve inches, in thickness.

THROAT. The inside of knee timber at the middle or turn of the arms. Also the midship part of the floor timbers.

THWARTSHIPS, or ATHWARTSHIPS. Across the ship, or from one side to the other. RIGHT-ATHWART, signifies square, or at right angles, with the keel.

TILLER. A piece of timber (which should be straight-grained and free from knots) fitted into the head of the rudder as a lever, for the purpose of moving it from side to side, in order to steer the ship. *See Inboard Works, Plate 4, and Upper-deck Plan, Plate 6.*

TIMBERS. A name given generally to the pieces of timber which compose the frame of a ship *(see Plate 2)*, as floor timbers, futtock timbers, and top timbers *(see Midship Sections, Plate 8)*; as also the stem or head timbers, and the stern timbers *(see Sheer Draught, Plate 1)*. Sometimes those carved ornaments upon the munions, in the stead of pilasters, are called stern timbers.

TIMBER and ROOM, or ROOM and SPACE. *See the latter.*

TONNAGE. The cubical content, or burthen, of a ship in tons; which is commonly estimated by a fantastical rule, given hereafter, producing what is denominated the Builder's Tonnage. The real burthen a ship is to carry, when brought down in the water to the load draught of water intended in the construction, may be found by the rules given in the subsequent part of this work.

The word is derived from a *Ton*, or weight of water equal to 2000 pounds; for, it appears that, anciently, a cubic foot of water, weighing 62½ pounds, was assumed as a general standard for liquids. This cubic foot, multiplied by 32, gives 2000, the original weight of a ton. Hence 8 cubic feet of water made a hogshead, and 4 hogsheads a ton, in capacity and denomination as well as weight.

TOP-HAMPER. Any unnecessary weight aloft, either on the topside of the ship or about its tops and rigging.

TOP and BUTT. A method of working English plank so as to make good conversion. As the plank runs very narrow at the top clear of sap, this is done by disposing the top end of every plank within six feet of the butt end of the plank above or below it, letting every plank work, as broad as it will hold clear of sap, by which method only can every other seam produce a fair edge. *See Planking, Plate 3.*

TOPSIDE. A name given to all that part of a ship's side above the main-wales.

TOP-TIMBERS. The timbers which form the topside. The first general tier which reach the top are called the long top-timbers, and those below are called the short top-timbers. *See* FRAMES. *See also Disposition, Plate 2, and Midship Sections, Plate 8.*

TOP TIMBER LINE. The curve limiting the height of the sheer at the given breadth of the top-timbers.

TOP TIMBER HALF-BREADTH. A section containing one half of the ship, at the height of the top-timber line, perpendicular to the plane of elevation.

TOP TIMBER SWEEP. *See* Frames.

TOUCH. The broadest part of a plank worked top and butt, which place is six feet from the butt end. Or, the middle of a plank worked anchor-stock fashion. Also the sudden angles of the stern-timbers at the counters, &c.

TRAIL-BOARDS. A term for the carved work, between the cheeks, at the heel of the figure.

TRANSOMS. The thwartship timbers which are bolted to the stern-post in order to form the buttock; and of which the curves, forming the *round aft*, are represented on the horizontal, or half-breadth plan of the ship. *See Sheer Draught, Plate* 1, *and Plate* 5 *of Laying off.*

TRANSOM-KNEES. Knees bolted to the transoms and the side of the ship in the direction of the transoms. These knees when they cross the transoms are called Sleepers.

TRANSPORTING. Moving a ship from one situation to another by hawsers only.

TRANSPORTING BLOCKS. Two snatch blocks, fitted on each side above the taffarel to admit a hawser, when transporting the ship from one place to another. *See Sloop, Plate* 10.

TRANSVERSE AXIS. *See* Conic Sections.

TRANSVERSE SECTION. A thwartship view of any part of the ship; but may be more properly applied when the section is not strictly athwartships. *See Midship Sections, Plate* 8.

TREAD of the KEEL. The whole length of the keel upon a straight line.

TRICING BATTENS. Battens about two inches thick and four inches broad, nailed up under the deck between the beams, and to which the sailors trice up the middle of their hammocks out of the headway.

To TRIM. To work or finish any piece of timber or plank into its proper form or shape.

TREENAILS. Cylindrical oak pins driven through the planks and timbers of a vessel to fasten or connect them together. These certainly make the best fastening when driven quite through, and caulked or wedged inside. They should be made of the very best oak, cut near the butt, and perfectly dry or well seasoned.

TRUSS. Short pieces of carved work, mostly in small ships, fitted under the taffarel in the same manner as the term pieces.

THE TUCK. The aft part of the ship where the ends of the planks of the bottom are terminated by the tuck-rail, and all below the wing-transom when it partakes of the figure of the wing-transom as far as the Fashion-pieces. *See* Square Tuck. *See also Yacht, Plate* 10, *and Plate* 6 *of Laying off.*

TUCK-RAIL. The rail which is wrought well with the upper side of the wing-transom, and forms a rabbet for the purpose of caulking the butt ends of the planks of the bottom. *See Sheer Draught, Plate* 1.

TUMBLING HOME, or Falling Home. The inclination of the topside from a perpendicular towards the centre or middle line of the ship. The topsides of three-decked ships have the greatest tumbling home, for the purpose of clearing the upper works from the smoke and fire of the lower guns. The advantages and disadvantages of tumbling-home sides will be found discussed hereafter.

VERTEX. The top or point of a Cone, Pyramid, &c.

The vertex of an angle is the angular point; and those angles which, being opposite to one another, do touch only in the angular point, are called vertical angles. *See Circle, fig.* 2. *Plate* A.

The vertex of any plane figure, is the angle opposite to the base; and the vertex of a curve, is the point from which the diameter is drawn, or the intersection of the diameter and curve. See the plate (B) of Conic Sections, wherein the points A and B, figure 11, are vertices of the Hyperbola.

VICE VERSA. A Latin phrase, importing *on the contrary.* Thus, increasing the breadth of the ship is the principal change of dimension for enlarging the tonnage; and, *vice versa*, decreasing the breadth reduces the tonnage.

VIS INERTIÆ. That property of resistance, in matter, by which all bodies are perfectly indifferent to motion and rest. For, in other words, a body, if once at rest, will naturally remain so, unless disturbed by some power acting upon it; and, a body in motion will continue that motion, in the same direction, and with the same velocity, unless stopped or impelled by some external cause.

Nature, in every case, evinces the first part of this proposition; since no part or portion of inanimate matter appears capable of giving itself any degree of motion. The latter part of the proposition, namely, that a body will continue its motion for ever, unless prevented by external force, is not so easy to illustrate; since we are not able to produce any species of motion which is not, in some degree, counteracted by the force of gravitation, or by some resisting medium. The conclusion, however, appears to be fairly drawn; since the least obstruction which is opposed to any body in motion increases in its effect as the motion continues. Thus a ball will continue longer in motion on a smooth than on an uneven surface; whence we may reasonably infer that, if all obstacles were completely removed, motion once communicated would never cease. *See* MOTION.

VIS INSITA. The innate force of matter, or power of resisting; by which every body, as much as in it lies, endeavours to persevere in its present state, whether of rest or of moving uniformly forward in a right line. This force is always proportional to the quantity of matter in the body, and differs in nothing from the *Vis Inertiæ* but in our manner of conceiving it.

UNDER. A term applied to any bevelling that is within a square, or forming an acute angle. *See* BEVELLING.

To UNSHIP. To remove any thing from its place, or the situation in which it is generally used. Thus, to unship the Tiller, is to take it out of the rudder-head.

VOYAL. A large rope, used to unmoor, or heave up the anchor, by communicating the effect of the capstan to the cable.

UPPER BREADTH SWEEP. *See* FRAMES.

UPPER-DECK. The highest of those decks which are continued, throughout the whole length of a ship, without falls or interruption. *See Inboard Works, Plate* 4, *and its Plan, Plate* 6.

UPPER HEIGHT OF BREADTH. *See* HEIGHT OF BREADTH.

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UPPER STRAKE of Boats. A Strake thicker than those of the bottom, wrought round the Gunwale. *See figure of the* Yawl.

UPPER-WORKS. A general name given to all that part of the ship above the Wales; or all that part which may be considered as separated from the bottom by the main wale. *See Sheer Draught, Plate* 1.

UPRIGHT. The position of a ship when she neither inclines to one side nor to the other. Hence, any thing is said to be upright when square with, or perpendicular to, the Keel.

As the ship, when building, lies with a declivity for the purpose of launching, it is evident, that every thing within her intended to be perpendicular, or upright, when afloat, must be set so much farther aft as its upper part or head inclines from a plumb or perpendicular in its length, according to the angle made by the declivity of the ship in the same length.

WAIST. A name given to that part of the topside above the upper deck, between the main and fore drifts. *See Sheer Draught, Plate* 1.

WALES. The principal strakes of thick stuff, wrought on the outside of the ship upon the main breadth, or broadest part of the body, and which are called the *Main Wales.* Also those that are wrought between the ports, which are called the Channel Wales and Middle or Sheer Wales. The *Main Wales* are the lower wales, which are generally placed on the lower breadth. See the respective articles. *See also Sheer Draught, Plate* 1.

WALL-SIDED. A term applied to the topsides of a ship when the main breadth is continued very low down and very high up, so that the topsides appear strait and upright like a wall.

WARD ROOM. The apartment in which the officers mess, &c. next under the captain's cabin.

WASH-BOARD. A shifting strake along the topsides of a small vessel, used occasionally to keep out the sea.

WATER LINES, or Lines of Floatation. Those horizontal lines, supposed to be described by the surface of the water on the bottom of a ship, and which are exhibited at certain depths upon the sheer-draught. Of these, the most particular are those denominated the *Light Water Line* and the *Load Water Line;* the former, namely, the Light Water Line, being that line which shews the depression of the ship's body in the water, when light or unladen, as when first launched; and the latter, which exhibits the same when laden with her guns and ballast, or cargo. *(See Sheer Draught, Plate* 1.*)* In the Half-breadth Plan these lines are curves limiting the Half-breadth of the ship at the height of the corresponding lines in the Sheer Plan.

WATER WAYS. The edge of the deck next the timbers, which is wrought thicker than the rest of the deck, and so hollowed to the thickness of the deck as to form a gutter or channel for the water to run through to the scuppers. *See Upper-deck Plan, Plate* 6, *and Midship Sections, Plate* 8.

WEDGE. A triangular solid, much used in the construction of a ship, and too well known to need description. It is one of the mechanic powers, the most simple and of the greatest force. *See* Mechanics.

WEIGHT. That quality in natural bodies whereby they tend downwards towards the centre of the earth. *See* Gravity. In common language, weight and gravity are considered as the same thing. There is, however, a distinction: as one may conceive gravity to be the quality, as inherent in the body, and weight the same quality exerting itself either against an obstacle or otherwise. Hence weight may be distinguished, like gravity, into absolute and specific. Sir Isaac Newton has demonstrated that the weights of all bodies, at equal distances from the centre of the Earth, are proportionable to the quantities of matter each contains. Hence the quantity of matter contained in a cubic foot of ebony is much greater than that contained in a cubic foot of fir, &c. *See* Specific Gravity.

WELL. The apartment formed in the middle of the hold, by bulkheads erected to inclose the pumps, and protect them from injury which might otherwise accrue from the lading and ballast, and also to give ready admittance for examining the state of the pumps, &c. *See Inboard Works, Plates 4 and 5.*

The Well in a fishing smack is a strong apartment to contain live fish, built water-tight in the middle of the hold, with a number of holes through its bottom, by means of which the fish are continually supplied with water, and preserved alive. *See Draught of the Smack.*

Well also implies in the same range or even with a surface.

WELL-GROWN. This term implies that the grain of the wood follows the shape required, as in knee-timber, &c.

WHELPS. The brackets or projecting parts of a capstan from the barrel. *See* Capstan. *And also Capstan, Plate 7.*

WHOLE MOULDED. A term applied to the bodies of those ships which are so constructed that one Mould made to the midship bend, with the addition of a floor hollow, will mould all the timbers, below the main breadth, in the square body.

Before the art of ship-building was brought to its present perfection, the method of whole moulding was in great repute, and was much practised by the unskilful; as, however, the art improved, this method became less approved of in the construction of ships, whose form of the midship-bend was required to be such, that if they were whole moulded nearly forward and aft, they would not only be incapable of rising in a heavy sea, but be deprived in a great measure of the more advantageous use of the rudder: for, by whole moulding, no more is narrowed at the floor than at the main breadth; nor must the rising line lift any more than the lower height of breadth; which, according to the form of some midship-bends, would make a very ill-constructed body.

How far whole moulding may be used without injury may be seen by the Long Boat treated of hereafter; Boats being now the only vessels in which this method is practised.

WINCH. A small windlass, with an iron axis, hung in rhodings or gudgeons, with a conical piece of timber at each end without the cheeks. It is hove round by two iron handles, formed by cranks or winches, from which it takes its name.

WINDING. Twisting or curving. Hence the expression "Winding" is used in opposition to "Out of Winding." *See* Out of Winding.

WINDLASS. An horizontal machine, composed of timber, and used in merchant ships for heaving up their anchors in lieu of a capstan. It is more fully described hereafter. *See Windlass, Plate* 7.

WINDLASS CHOCKS. Pieces of oak or elm, fastened to the sides of small vessels, and by which the ends of the Windlass are suspended.

WINGS. The places next the side upon the orlop, usually parted off in ships of war, that the carpenter and his crew may have access round the ship, in time of action, to plug up shot-holes, &c. *See Orlop Plan, Plate* 5.

WING-TRANSOM. The uppermost transom in the stern frame, upon which the heels of the counter timbers are let in and rest. It is by some called the main transom. *See Shee Draught, Plate* 1.

WITHIN-BOARD. Within the ship.

WITHOUT-BOARD. Without the ship.

WOOD and WOOD. This term implies that when a treenail, &c. is driven through, its point is directly even with the inside surface, whether plank or timber.

WOOD-LOCK. A piece of elm, or oak, closely fitted, and sheathed with copper, in the throating or score of the pintle, near the load water-line; so that, when the rudder is hung, and the wood-lock nailed in its place, it cannot rise, because the latter butts against the under side of the Brace and butt of the score. *See Sloop of War, Plate* 10.

WRAIN BOLTS. Ring bolts, used when planking, with two or more forelock holes in the end for taking-in the sett as the plank, &c. works nearer the timbers.

WRAIN STAVES. A sort of stout billets of tough wood, tapered at the ends so as to go into the ring of the wrain bolt to make the setts necessary for bringing-to the planks or thick-stuff to the timbers.

WRUNG-HEADS. An ancient name given to that part of the ship near the floor heads and second futtock heels, which, when a ship lies aground, bears the greatest strain.

YARDS. The long cylindrical pieces of timber, suspended upon the masts to extend the sails to the wind.

YACHT. A vessel of state or pleasure, usually employed to carry noble personages, and accordingly fitted with convenient apartments and suitable furniture.

YAWL. *See* Boats.

CHAPTER II.

OF FLUIDS, AND THEIR ACTION ON FLOATING BODIES, AS INVESTIGATED BY ACTUAL EXPERIMENT.

Of all the considerations, which naturally present themselves, preparatory to the construction of a navigable vessel, it is obvious, that the first must arise from the nature of the fluids in which it is to move, and by which it is to be actuated and supported.

This subject, therefore, presents itself as the primary object of our discussion; and as the means of investigating the best forms of vessels intended for navigating the ocean, whether for particular or general services, and required to possess, in a peculiar degree, either the qualities best adapted for expedition, strength, or capacity; or, so far as is practicable, a combination of the whole.

In the present chapter we shall, consequently, briefly explain the nature of fluids; and shall, secondly, shew the manner in which they are found to operate upon bodies of various forms, as navigable vessels.

§ 1. OF THE NATURE AND ACTION OF FLUIDS IN GENERAL.

The only fluids which become the subjects of our present consideration are, Common Air, or the air we breathe, and Water. But especially the latter. The former, in a general sense, is that invisible fluid, or atmosphere, surrounding the globe on which we live; and on which depends not only animal but vegetable life. Air is reckoned amongst the number of fluids, because it has all the properties by which a fluid is distinguished; for, it yields to the least force impressed, its parts are easily moved among one another, it presses according to its perpendicular height, and its pressure is every way equal.

Air differs from all other fluids in the three following particulars. 1. It can be compressed into a much less space than that which it naturally possesses. 2. It cannot be congealed or fixed, as other fluids may. 3. It is of a different density in every part, upward, from the earth's surface; decreasing in its weight, bulk for bulk, the higher it rises; and therefore also decreasing in density. 4. It is of an elastic nature; and the force of its spring is equal to its density.

That air is a body is evident, from its excluding all other bodies out of the space it possesses:

for, if a hollow vessel, as a jar, be plunged, with its mouth downwards, into a vessel of water, but very little water will get into the jar, because the air, of which it is full, keeps the water out. As air is a body, it must needs have gravity or weight: and that it is weighty is demonstrated by experiment. For, if air be excluded from a vessel by means of the air-pump, the vessel is found to be lighter than when filled. A bottle that holds a wine quart is found to be seventeen grains lighter. Now, as a quart of water weighs 14625 grains; this, divided by 17, quotes 860 in round numbers; which shews that water is 860 times as heavy as air near the surface of the earth.

As the air rises above the earth's surface, it grows rarer, and consequently lighter, bulk for bulk; for, since it is of an elastic or springy nature, and its lowermost parts are pressed with the weight of all that is above them, it is plain that the air must be more dense or compact at the earth's surface than at any height above it; and gradually rarer the higher up. For the density of the air is always as the force that compresseth it: and therefore the air towards the upper parts of the atmosphere being less pressed than that which is near the earth, it will expand itself and thereby become thinner than at the earth's surface.

It has been demonstrated that, if altitudes in the air be taken in arithmetical proportion, the rarity of the air will be in geometrical proportion. That is to say, at the altitude of seven miles above the surface of the earth, the air is four times lighter and thinner than on the earth's surface; but, at twice that height, or at the altitude of fourteen miles, it is sixteen times thinner, &c.

The weight or pressure of the air may be exactly determined by the following experiment. Take a glass tube, about three feet long, and open at one end; fill it with quicksilver, and, putting your finger upon the open end, turn that end downward, and immerse it in a small vessel of quicksilver, without letting in any air; then take away your finger, and the quicksilver will remain suspended in the tube $29\frac{1}{2}$ inches above its surface in the vessel; sometimes more and at other times less, as the weight of the air is varied by wind and other causes. That the quicksilver is kept up in the tube by the pressure of the atmosphere upon that in the bason, is evident; for, if the bason and tube be put under a glass, and the air be then drawn out of the glass, all the quicksilver in the tube will fall down into the bason; and, if the air be let in again, the quicksilver will rise to the same height as before. Therefore the air's pressure on the surface of the earth is equal to the weight of $29\frac{1}{2}$ inches depth of quicksilver, in every part of the earth's surface, at a mean rate. A square column of quicksilver, $29\frac{1}{2}$ inches high, and one inch thick, weighs just 15 pounds, which is equal to the pressure of air upon every square inch of the earth's surface; and 144 times as much, or 2160 pounds upon every square foot; because a square foot contains 144 square inches. At this rate, a middle sized man, whose surface may be about 14 square feet, sustains a pressure of 30,240 pounds, when the air is of a mean gravity: a pressure which would be insupportable, and even fatal, were it not equal on every part, and counterbalanced by the spring of the air within us, which is diffused through the whole body, and re-acts with an equal force against the outward pressure.

When the end of a pipe is immersed in water, and the air is drawn out of the pipe, the water will rise in it to the height of 33 feet above the surface of the water in which it is immersed; but will go no higher: for it is found, that a common pump will draw water no higher than

33 feet above the surface of the well; and unless the bucket goes within that distance from the well, the water will never get above it. Now, as it is the pressure of the atmosphere on the surface of the water in the well that causes the water to ascend in the pump, and follow the piston or bucket, when the air above it is lifted up; it is evident that a column of water, 33 feet high, is equal in weight to a column of quicksilver, of the same diameter, 29½ inches high; and to as thick a column of air, reaching from the earth's surface to the top of the atmosphere. In serene calm weather, the air has weight enough to support a column of quicksilver 31 inches high; but in tempestuous stormy weather, not above 28 inches. Hence the quicksilver, thus supported in a glass tube, is found to be a nice counterbalance to the weight of the air, and is accordingly used to shew its perpetual fluctuations.

As the air presses with equal force in all directions, not only downwards, but slanting, sideways, and upwards, it preserves its equilibrium every way; the softest bodies, of course, sustain it without suffering any change in their figure, as do the most brittle without being broken. But, if the pressure be taken off from any one particular part, the full force of it, in an opposite direction, will be immediately found.

The most essential particular in which Air differs from Water and other liquid fluids is its elasticity, or wondrous powers of expansion and condensation. This elastic quality is that by which, like a spring, it allows itself to be compressed into a smaller bulk, and by which it again dilates to its original space upon removing the pressure.

The utmost limit to which air, of the density which it possesses at the surface of the earth, is capable of being compressed is unknown. It has certainly been compressed into less than 1500 times less space than it naturally occupies. Its dilatation has been also found to be very surprising. Mr. Boyle once caused it to dilate into 13679 times its natural space; and this altogether by its own expansive force. Hence it appears, that the air, near the surface of the earth, is compressed into at least the 13679th part of the space it would possess in *vacuo*.

That the air is constituted of particles endued with repulsive powers is manifest from its expansion, when the force with which it is compressed is removed. The particles being kept at a distance by their mutual repulsion, it is easy to conceive that they may move very freely amongst each other, and that this motion may take place in all directions, each particle exerting its repulsive power equally on all sides. Thus far we are acquainted with the constitution of this fluid; but with what absolute degree of facility, and how this may be effected under different degrees of compression, are circumstances of which we are ignorant.

WATER. Water is not a simple elementary substance, as it has long been supposed, but appears to be compounded of two elements, named by the chymists, *Oxygene* and *Hydrogene*, or pure and inflammable air, which are capable, when united, of decomposition or condensation into water, by means of fire *. It is known to be the most penetrative of all bodies, after fire; and is said to be more fluid than air, since it will find its way through smaller pores. In-

* The discovery of the generative principle of water is included amongst the greatest discoveries in physical science of the present age. One hundred grains of water consist of 85 grains of *oxygene*, otherwise called vital or pure air; and 15 of the base of inflammable gas, or *hydrogene*, which signifies the generative principle of water.

finitely small, however, as its particles or constituent parts must be, they are universally considered as hard and spherical; every particle of itself a solid consistent body, no fluid singly, but becoming so only on being joined with particles of the same kind. We suppose them to be so, because it is otherwise extremely difficult to conceive how they can move amongst each other with such extreme facility, and produce effects in directions opposite to the impressed force without any sensible loss of motion. If the particles be not in contact, they must be kept at a distance by some repulsive power. But it is manifest that these particles attract each other from the drops of all perfect liquids affecting to form themselves into spheres; and the repulsion seems as evident from the expansion of water by heat, and the possibility of converting it into two permanently elastic fluids *; for it is hard to conceive that heat can actually create any new powers, or that it can of itself produce any such effects. Hence we may admit the existence both of attraction and repulsion ; and, suppose that, where one ends the other begins.

Water, as we have before observed, is 860 times heavier than common air. That its particles must be hard, and touch each other, appears from its incompressibility. For it is known, by experience, that it cannot be compressed or forced into less space than it naturally occupies by any mechanical means that can be employed upon it. That it will float the greatest and heaviest bodies which occupy more space than itself is a fact too well known to need explanation here †. Its power and pressure increase according to its altitude, regardless of its quantity, as we shall presently shew; and, as it is incompressible, and presses equally in all directions, if we suppose a tight dock to be made that would nearly fit to the bottom of the largest ship of war to her floating mark—half an inch, or the least thickness, of water, would lift and float this ship as effectually as the whole ocean.

That fluids have vacuities will become evident upon mixing salt with water, a certain quantity of which will be dissolved, and thereby imbibed, without enlarging the dimensions; the fluid may also still receive a certain quantity of other dissoluble bodies, whose particles are adapted to the vacancies remaining, without adding to the bulk, although the absolute weight of the whole fluid be thereby increased. This is demonstrable by weighing a phial of rain water, critically, with a nice balance: pour this water into a cup, and add salt to it; refund as much of the clear liquor as will again fill the vial; an increase of weight will be found under the same dimensions, from a repletion of the vacuities of the fresh water with the saline particles; after which it will receive a certain quantity of sugar; and, after that, a certain quantity of alum, and perhaps other dissoluble bodies, and not increase its first dimension.

We may, of course, consider water as composed of an infinity of corpuscles, or small elementary particles, of which the figures are unknown; and every particle, in itself, as in a state of rest, and as forming an equilibrium to all the particles that press on and surround it. This principle seems to require no other demonstration than that,—If a fluid particle were not equally pressed on all sides in the midst of that body of fluid, of which it forms a part, it would of

* Pure and Inflammable Air.

† See the article SPECIFIC GRAVITY in the preceding Chapter.

course move to the side least pressed; but, as the fluid is supposed to be in a perfect state of rest, it will, of course, be admitted, that the equal pressure is in all directions; of which experience furnishes us with convincing and ample proofs.

We must consider the action of water either as the joint action of all the corpuscles of which it is composed, estimated as so many distinct bodies, or we must consider the action of the whole as a mass, or as one body. In the former case, the motion of the particles being subject to no regularity, or at least to none that can be discovered by experiment, it is impossible from this consideration to compute the effects; for no calculation of effects can be applied when produced by causes which are subject to no law. And, in the latter case, the effects of the action of one body upon another differ so much, in many respects, from what would be its action as a solid body, that a computation of its effects can by no means be deducted from the same principles.

In Mechanics no equilibrium can take place between two bodies of different weights, unless the lighter act at some mechanical advantage; but, in Hydrostatics, as we have already noticed, a very small weight of fluid may, without its acting at any mechanical advantage whatever, be made to balance a weight of any magnitude. In mechanics, bodies act only in the direction of gravity; but the property which fluids have, of acting equally in all directions, produces effects of such an extraordinary nature as to surpass the power of investigation. The indefinitely small corpuscles of which a fluid is composed, probably possess the same powers, and would be subject to the same laws of motion, as bodies of finite magnitude, could any two of them act merely upon each other by contact: but this is a circumstance which certainly never takes place in the aerial fluid, and probably not in any liquids. Under the circumstances, therefore, of an indefinite number of bodies acting upon each other by repulsive powers, or by absolute contact, under the uncertainty of the friction which may take place, and what variation of effects may be produced under different degrees of compression, it is no wonder that theory and experiments should be so often found to disagree.

FROM THE PRINCIPLES OF HYDROSTATICS we learn,

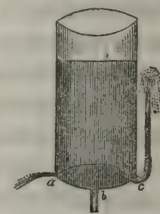
I. That, if one part of a fluid be higher than another, the higher parts will continually descend to the lower, and will not be at rest, until the surface be quite level. For the parts of a fluid, being moveable every way, if any part is above the rest, it will descend by its own gravity as low as possible, until all will be reduced to a level or horizontal plane.

II. If a fluid be at rest in a vessel or canal, whose base is parallel to the horizon, equal parts of the base will be equally pressed by it: for each part supports an equal column of the fluid, and all the columns being of equal weight, they must press the base equally; or equal parts of the base must sustain an equal pressure.

Hence all parts of the fluid, at the same depth, press equally; for suppose a plane drawn through the fluid parallel to the horizon, then the pressure will be the same in any part of that plane, which proves the inference.

From this proposition it also follows, that the pressure of the fluid at any depth, is as the depth of the fluid. For the pressure is as the weight, and the weight is as the height of a column of the fluid.

III. If a fluid is compressed by its weight, or otherwise, then, at any point, it presses equally in all manner of directions. This arises from the nature of fluidity, which causes it to yield to any force in any direction. If it cannot give way to any force applied, it will press against other parts of the fluid in direction of that force : and the pressure in all directions will be the same; for, if one force was less, the fluid would move that way till the pressure became every way equal. Hence, in any vessel, containing a fluid, the pressure is the same against the bottom, as against the sides, or even upwards at the same depth: and, if there be holes at an equal depth, in any vessel, as at a b and c, the water will spout out with the same velocity, or very nearly so, whether it be downwards, sideways, or upwards; and, if it be upwards, it ascends nearly to the height of the water above the hole, as represented in the annexed figure, and would ascend to the level of the inclosed fluid but for the resistance of the external air.

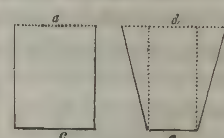


It is therefore obvious, that fluids have this singular and wonderful property, not only as solids, of pressing downwards by the force of gravity, but also that their pressure upwards and sideways is equal to their pressure downwards, and which is always in proportion to their *perpendicular height* without any regard to their quantity.

IV. The pressure of the fluid upon the base of any containing vessel or place is as the base and *perpendicular* altitude, whatever be the figure of the vessel that contains it. For, by proposition II, above, if the heights be equal, the pressure upon an inch of one base will be equal to the pressure of one inch upon the base of another, therefore the pressure on the bases will always be in proportion to their respective dimensions.

Hence, if the heights be equal, the pressures are as the bases; and if both the heights and bases are equal, the pressures in each are equal, although their contents be ever so different.

For example, we will suppose the figure a c to be the transverse section of a vessel or canal, with perpendicular sides, filled with water; and d e to be that of another with oblique sides. In this case, the wider canal has no greater pressure at the bottom than the narrower one, because the oblique sides take off part of the weight. And, in the narrower one the sides re-act against the pressure of the water, which is all alike at the same depth; and by this re-action the pressure is increased at the bottom so as to become every where the same.



Consequently, the pressure against the base of any containing vessel, &c. is the same as of a cylinder of equal base and height.

V. If a body, having the same specific gravity of a fluid, be immersed in such fluid, it will rest in any place of it. A body of greater density will sink, and one of less density will swim. For let the three bodies be denoted by A, B, and C: the specific gravity of A being lighter than that of the fluid, that of B, equal to the specific gravity of the fluid, and that of C, greater than B. Now the body B, being equal in weight to a like portion of the fluid, it will press the fluid under it just as much as if the space it occupies was filled with the fluid; and, consequently, the pressure will be the very same all around it as though the fluid was there, and hence there will be no force to put it out of its place. But if the body be lighter, the pressure downwards being less than before, or than in other places of the fluid at the same depth, the less force must consequently give way, and the body will rise to the top. If the body be heavier, the like pressure being greater than in the former cases, or greater than in other parts of the fluid, such pressure will prevail, and so the body will descend to the bottom of the fluid. From this proposition are deduced the following corollaries:

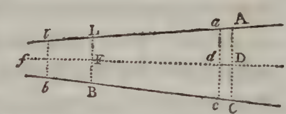
1. If several bodies of different specific gravities be immersed in a fluid higher than they, the heaviest will descend the fastest, and get the lowest.

2. A body immersed in a fluid, loses as much weight as an equal quantity of the fluid weighs; and the fluid gains it.

3. All bodies of equal magnitudes lose equal weights in the same fluid; and bodies of different magnitudes lose weights proportional to the magnitudes.

4. The weights lost in different fluids, by immersion of the same body, are as the specific gravities of the fluids; and bodies of equal weight lose weights in the same fluid reciprocally as the specific gravities of the bodies.

5. The weight of a body swimming in a fluid is equal to the weight of as much of the fluid as the immersed part of the body occupies; and hence a body will sink deeper in a lighter fluid than in a heavier.



VI. If a fluid runs through a pipe of unequal size, so as to fill it completely up within the extent of its volume, the velocity of the fluid in different parts of the pipe will be in a reciprocal proportion to the transverse sections in these parts: for supposing AC and LB to be transverse sections of the pipe, let the part of the fluid ACBL come to the place acbl: then will the solid acbl be equal to the solid ACBL; and taking away the part acBL, common to both, we have ACca equal to LBbl.

Now, in equal solids, the bases * and the heights are reciprocally proportional; that is, as one increases the other decreases, and *vice-versa*. Likewise, if Df be the axis of the pipe, the heights Df Ff passed through in equal times will be as the velocities; and, therefore, as the area of the section AC is to that of the section LB, so is the velocity along Ff to the velocity along Dd †.

VII. The velocity with which water spouts out at a hole in the side or bottom of a vessel is as the square root of the depth or distance of the hole below the surface of the water. For, in order to make *double* the quantity of a fluid run through one hole as through another of the same size, it will require four times the pressure of the other, and therefore must be four times the depth of the other below the surface of the water: and, for the same reason, three times the quantity running in an equal time through the same sort of hole, must run with three times

* The base of a stream, or volume of fluid in motion, is an imaginary plane, perpendicular to the direction of the stream, whose area is equal to that of a transverse section of the volume of fluid.

† It is to be observed that in this and other propositions of mechanical philosophy, allowance must always be made for the friction or adhesion of one sort of matter to another. In the present case, for instance, if the pipe be of wood, allowance must be made for the quantity of surface in contact with the fluid, and to which the latter adheres, more or less, according to its viscidity, and according to the degree of smoothness in the surface. The nature of this adhesion, which has been called the *friction of the water*, is more fully explained hereafter.

the velocity, which will require nine times the pressure; and, consequently, must be nine times as deep below the surface of a fluid, &c.

As the pressure of water, in all directions, increases in proportion to its depth, it follows that, if a ship has the flattest part of her bottom at the depth of 16 feet from the surface, (which is the case in large ships,) the water then presses 16 times as much upwards against this flat part, as it does on any part of the ship about the water's edge, and so on in any part according to its depth. And, suppose this ship to have four leaks, or plug-holes, of equal size, that could be driven out occasionally, the first at one foot under water, the second at four feet, the third at nine feet, and the lowest at sixteen feet, in the flat part of the bilge; that hole at four feet deep would leak or let in double the quantity of water in the same time as that at one foot deep; and that at nine feet, three times as much; and that at sixteen feet, four times as much; although it run into the ship upward; and so in proportion to the square root of the height of the water above the leak or plug-hole: therefore leaks in ships are more or less dangerous according to their depth under water.

The great Dr. Halley says, "That the pressure of the water at thirty-three feet deep (which is equal to the weight of the atmosphere) pressed the natural air into half its space in his diving bell." And, by many experiments made by Mr. W. Hutchinson *, it appears, that the pressure of water upon bottles of different shapes corked up with nothing in them but common air, was as follows. Two common square flat-sided case bottles, which would hold three half-pints each, broke at the depth of between six and seven fathoms; but two oval formed thin Florence flasks, of nearly the same size, bore the pressure to about fifteen fathoms; and a quart bottle, round one way, but having two sides somewhat flattened, bore fifteen fathoms. A round common quart bottle broke only at about twenty-eight fathoms. It seems that, at great depths, few things that are made hollow and tight will bear the water's pressure; an instance of which has been seen by a ship that drove off the bank in Gibraltar Bay, into water so deep that the anchors would not reach the ground at a hundred fathoms: and, when hove up it was found that two new nun-buoys had their sides crushed inwards by the water's pressure.

§ 2. OF THE RESISTANCE OF FLUIDS.

We know, by experience, that force must be applied to a body at rest in order to give it motion in such a fluid as water; and that a body projected with any velocity in a fluid at rest is gradually retarded in its motion and brought into a state of rest. The analogy of nature makes us therefore imagine that there is a force acting in the opposite direction, or opposing the motion, and that this force resides in, or is exerted by, the fluid. Hence, we give to this supposed force the name of Resistance. We also know that a fluid in motion will hurry a solid body along with the stream, and that it requires force to maintain it in its place. From a similar analogy

* Author of the Treatise on "Practical Seamanship."

we therefore call this the IMPULSION of a fluid*. And, as our knowledge of nature informs us that the mutual actions of bodies are in every case equal and opposite, or very nearly so, and that the observed change of motion is the only indication and measure of the changing force, we infer that the forces are the same, or very nearly the same, (whether called impulsions or resistances,) when the relative motions are the same, and therefore depend entirely on these relative motions. The force, therefore, which is necessary for keeping a body immoveable in a stream of water, flowing with a certain velocity, is the same, or very nearly the same†, with what is requisite for moving such body with an equal velocity through stagnant water.

A body in motion appears to be resisted by a stagnant fluid, because it is a law of mechanical nature that force must be employed to put any body in motion. Now the body cannot move forward without putting the contiguous fluid in motion, and force must be employed for producing this motion. In like manner, a quiescent body is impelled by a stream of fluid, because the motion of the contiguous fluid is diminished by this solid obstacle; the resistance, therefore, or impulse, differs but little from the ordinary communications of motion among solid bodies.

The THEORY of RESISTANCE is a subject which has exercised the extraordinary talents of several of the most distinguished mathematicians of the last century. Nevertheless, it is a subject which is as yet but very imperfectly known. It seems that Sir Isaac Newton was the first who attempted to make the motions and actions of fluids the subject of mathematical discussion. Yet even he, with all his genius and all his science, was at length convinced that it was in vain to expect an accurate investigation of the motions and actions of fluids where millions of unseen particles combine their influence, &c. He, however, figured in his mind an hypothetical theory; and, from this hypothesis, deduced a series of propositions which formed the basis of all the theories of the impulse and resistance of fluids that have been offered to the public since his time.

From these theories the following principles were deduced as the Laws of the Resistance, &c. of Fluids. We give them here in order to shew how far they have been found to agree with actual experiment, in what respects they differ, and to prevent the young artist from retaining those erroneous ideas of the subject which he may, perhaps, have already acquired.

1. "The Resistances, and (by the laws of motion) the Impulsions, of Fluids on similar bodies "are proportional to the surfaces of the solid bodies, to the densities of the fluids, and to the "squares of the velocities, jointly."

2. "The direct impulse of a fluid on a plane surface is to its oblique impulse, on the same "surface, as the square of the radius is to the square of the sine of the angle of incidence."

3. "The direct impulse on any surface is to the oblique impulse, on the same surface, as the cube "of radius to the solid which has for its base the square of the angle of incidence, and the sine "of obliquity for its height."

* These terms are more particularly defined in the foregoing Chapter.

† We say, *very nearly the same,* because it appears by accurate *experiment* that there is, in some cases, a small difference, as will be shewn hereafter.

4. "The direct impulse of a stream of fluid, whose breadth is given, is to its oblique effective "impulse in the direction of the stream as the square of radius to the square of the sine of the "angle of incidence."

The numerous experiments with which these propositions have been compared, have most decidedly proved that they are, with the exception of the first, exceedingly erroneous: and even that is not in all cases correctly true, as will be seen hereafter; but the deviation is, in general, of little consequence in practice.

It is to Experiment, and perhaps to Experiment alone, that we are to look for the basis of a true theory of Resistance and Impulsion.—We have, in support of this observation, not only the individual opinions of many intelligent men, best acquainted with the subject, but also the unanimous opinion of that most respectable Society, instituted at London some years since, for the Improvement of Naval Architecture, under whose directions were made, between the years 1793 and 1798, several thousand experiments for the ascertainment of this important object; and likewise, the opinion of several of the most distinguished members of the French Academy of Sciences, by whom a series of Experiments had also been previously made.

PROPOSITIONS RELATIVE TO RESISTANCE.

I. "The Resistance which any body meets with in moving through a fluid is nearly as the "square of the velocity; for the resistance of a fluid may be considered as compounded of the "number of particles struck, and the velocity with which one particle is struck. Now, the "number of particles struck in any time being as the velocity, it follows that the whole resistance "will be as the square of the velocity nearly.

"Hence, if a stream of water, whose diameter is given, strike against an obstacle at rest, the "force against it will be nearly as the square of the velocity of the stream.

II. "The centre of resistance of any plane, moving directly forward in a fluid, is the same "as the centre of gravity. Or, it is that point to which, if a contrary force be applied, it shall "just sustain the resistance. Now, the resistance is equal upon all equal parts of the plane, "and, therefore, the resistance acts upon the plane after the same manner, and with the same "forces, as gravity does; consequently, the centre of both the resistance and gravity must be "the same.

"Therefore, in any body moving through a fluid, the line of direction of its motion will pass "through the centre of resistance, and centre of gravity, of the body. For, if it do not, the "forces arising from the weight and resistance will not balance each other; which will cause the "body to librate or oscillate in the fluid, till by degrees the situation of these two centres will "fall into the line of their motion*."

* In the generally received theory of hydraulics several other propositions may be found relative to the subject of Resistance, and which we have omitted. They are omitted, not only as they are of little utility, but as they appear to

In the experiments made with bodies floating on the surface of the water, there is found to be an addition to the resistance arising from the inertia of the water. The water heaps up a little on the anterior or head surface of the floating body, and is depressed behind it. Hence arises a hydrostatical pressure on the head surface acting in concert with the true resistance, to which the term of PLUS PRESSURE has been applied.

Independent of this there is an addition to the resistance which arises from the tendency to rarefaction behind every body in swift motion; because the pressure of the surrounding fluid can only make the fluid fill the space left with a determined velocity. For, it is evident, that, if the water which glides past the body cannot fall in behind it with a sufficient velocity for filling up the space behind, there must be a void there; or, rather, a subtraction from that pressure of the water which would otherwise tend to support the after part of the vessel, which must be considered as a super-addition to the resistance, and which is signified by the term MINUS PRESSURE.

By way of illustration we may add, that it has frequently been observed, from the poop of a second-rate man of war, when sailing at the rate of 11 miles an hour, which is equal to a velocity of 16 feet per second nearly, not only that the back of the rudder was naked for about two feet below the load water-line, but also that the trough or wake made by the ship was filled up with water which was broken and foaming to a considerable depth, and to a considerable distance from the vessel. While this broken or dead water is observed, there must, of course, be a partial diminution of pressure, which will operate as an additional resistance. Or, in other words, a subtraction of pressure from the stern pressure, which is occasioned by the fluid's not pressing so strongly against the stern when the vessel is in motion as when it is at rest.

The terms of PLUS and MINUS PRESSURE, with several others which it will be necessary to make use of in the ensuing part of this treatise, will be more clearly understood from the following

DEFINITIONS AND EXPLANATORY OBSERVATIONS,

For which the public is indebted to the pen of the RIGHT HONOURABLE EARL STANHOPE.

1. By HEAD PRESSURE is meant, the total pressure which exists against the head end or foremost part of a body, immersed either wholly or in part in any given fluid, when such body is at rest.

2. By STERN PRESSURE is meant, the total pressure which exists against the stern end or hindermost part of a body, immersed either wholly or in part in any given fluid, when such body is at rest.

3. By PLUS PRESSURE is meant, the *additional* pressure which is sustained by the head end or foremost part of a body, moved through a fluid; which additional pressure is *over and above*

be founded on erroneous, or, at least, very uncertain, data. The scientific reader, who wishes to be acquainted with their defects, is particularly referred to the Rev. S. Vince's " Observations on the Theory of the Motion and Resistance of Fluids," in the Philosophical Transactions of the years 1795 and 1798.

what is termed the Head Pressure, and arises from the fluid's being obliged to be displaced in order to permit the moving body to pass through it.

4. By Minus Pressure is meant a *subtraction of pressure from the stern pressure*, and which subtraction is occasioned by the fluid not pressing so strongly against the stern end, or hindermost parts of a body, when such body is in motion through the fluid, as when the body is at rest.

5. By Friction (as relating to this subject) is meant, that sort of resistance to a body, moved through a fluid, which arises either from the adhesion of the particles of the fluid to the surface of the moving body, or from the roughness of the body, or from both these causes united.

6. By Total Resistance is meant, the sum total of the Plus Pressure, the Minus Pressure, and the Friction, united.

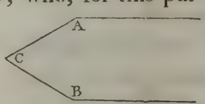
7. By Head Resistance is meant, the Plus Pressure and the friction of the water against the head end united.

8. By Stern Resistance is meant, the Minus Pressure and the friction of the water against the stern end united.

Having premised thus much, we shall proceed to give, in the following section, an account of the experiments which have been made for determining the Resistance of floating bodies; and, first, of those which were made, at the expence of the French Government, by a committee of the Royal Academy of Sciences.

§ 3. EXPERIMENTS WHICH HAVE BEEN MADE FOR DETERMINING THE RESISTANCE, &c. OF FLOATING BODIES.

I. The Committee, by whom the Experiments of the French Academy were made, consisted of the Marquis de Condorcet, M. d'Alembert, M. l'Abbé Bossut, and others; who, for this purpose, made use of fifteen boxes or vessels which were two feet wide, two feet deep, and four feet long. One of them was a parallelopiped of these dimensions; the others had prows, or head ends, of a wedge form, thus:



The angle ACB varying by 12 degrees, from 12 degrees to 180, or a direct plane; so that the angle of incidence increased by six degrees from one to another. These boxes were dragged across a very large bason of still water, (in which they were immersed two feet,) by means of a line, passing over a wheel, connected with a cylinder, from which the actuating weight was suspended. The motion became perfectly uniform after a very little way; and the time of passing over 96 French feet, with this uniform motion, was carefully noted.

The resistance was measured by the weight employed, after deducting a certain quantity for friction, and for the accumulation of the water against the anterior or head surface. The results of the many experiments are given in the following Table.

Angle of the Head End.	Resistance according to Theory.	Resistance according to Experiment.	Difference between Theory & Experiment.
180°	10000	10000	0
168	9890	9893	+ 3
156	9568	9578	+ 10
144	9045	9084	+ 39
132	8346	8446	+ 100
120	7500	7710	+ 210
108	6545	6925	+ 380
96	5523	6148	+ 625
84	4478	5433	+ 955
72	3455	4800	+ 1345
60	2500	4404	+ 1904
48	1654	4240	+ 2586
36	955	4142	+ 3187
24	432	4063	+ 3631
12	109	3999	+ 3890

The resistance to one square foot, French measure, moving with a velocity of 2.56 feet per second, was very nearly 7.625 pounds French. Reducing these to English measures, we have the surface equal to 1.1363 feet, the velocity of the motion equal to 2.7263 feet per second, and the resistance equal to 8.234 pounds avoirdupois.

There is a great diversity in the values which different authors have deduced for the absolute resistance of water from their experiments. In the value now given, nothing is taken into account but the inertia of the water. The accumulation against the fore part of the box was carefully noted, and the statical pressure backwards, arising from this cause, was subtracted from the whole resistance to the drag. A sufficient variety of experiments were not made for discovering the share which tenacity and friction produced; so that the number of pounds set down here may be considered as somewhat superior to the mere effects of the inertia of the water.

From these experiments we may perceive that the effects of the obliquity of incidence deviate enormously from the theory of the mathematicians*; and that this deviation increases rapidly

* In the *Discours Preliminaire* of "*L'Examen Maritime*" of Don George Juan—"Our experiments (says the author) most satisfactorily prove, that the resistance which a body meets with, when moving in a fluid, is not in proportion to the square of the velocity and the square of the sine of the angle of incidence, but it is as the simple velocity, and as the sine, simply, of the angle of incidence."

According to this theory, which it will appear is incorrect, although much more accurate than the former, "the resistance will be in proportion to the density of the fluid; to the surface exposed to the shock; to the square root of the depth at which it is immersed; and to the simple angle of incidence."

as the acuteness of the prow, or head end, increases. In the prow of 60 degrees the deviation is nearly equal to the whole resistance pointed out by the theory; and, in the prow of 12 degrees, it is nearly 40 times greater than the theoretical resistance.

These experiments are very conformable to those of other authors on plane surfaces. Mr. Robins found the resistance of the air to a pyramid of 45 degrees, with its apex foremost, was to that of its base as 1000 to 1411 instead of one to two. Chevalier Borda found the resistance of a cube, moving in water in the direction of the side, was to the oblique resistance, when it was moved in the direction of the diagonal, in the proportion of $5\frac{1}{3}$ to 7; whereas, by the theory, it should have been that of the square root of 2 to 1, or of 10 to 7 nearly. He also found, that a wedge, whose angle was 90 degrees, moving in air, gave for the proportion of the resistances of the edge and base 7281 to 10000, instead of 5000 to 10000. Also, when the angle of the wedge was 60 degrees, the resistances of the edge and base were 52 and 100, instead of 25 and 100.

In short, in all the cases of oblique plane surfaces, the resistances were greater than those which are assigned by the theory. The theoretical law agrees tolerably with observation in large angles of incidence, that is, in incidences not differing very far from the perpendicular; but in more acute prows the resistances are more nearly proportional to the sines of incidence (simply) than to their squares.

As the very nature of naval architecture seems to require curvilineal forms, in order to give the necessary strength, it seemed of importance to examine more particularly the deviations of the resistances of such prows from the resistances assigned by the theory. The Academicians therefore made vessels with head-ends of a cylindrical shape; one of these was a half cylinder, and the other was one third of a cylinder, both having the same breadth, viz. two feet, the same depth, also two feet, and the same length, four feet. The resistance of the half-cylinder was to the resistance of the perpendicular prow in the proportion of 13 to 25, instead of being as 13 to 19.5. The Chevalier Borda found nearly the same ratio of the resistances of the half-cylinder, and its diametrical plane when moved in air. He also compared the resistances of two prisms or wedges of the same height and breadth. The first had its sides plane, inclined to the base in angles of 60 degrees: the second had its sides portions of cylinders, of which the planes were the chords, that is, their sections were arches of circles of 60 degrees. Their resistances were as 133 to 100, instead of being as 133 to 220, as required by the theory; and, as the resistance of the first was greater in proportion to that of the base than the theory allows, the resistance of the last was less.

Mr. Robins found the resistance of a sphere moving in air to be to the resistance of its great circle as 1 to 2.27; whereas the mathematical theory requires them to be as 1 to 2. Borda found the resistance of the sphere moving in water to be to that of its great circle as 1000 to 2508. He also found the resistance of air to the sphere was to its resistance to its great circle as 1 to 2.45.

It appears, on the whole, that the theory gives the resistance of oblique plane surfaces too small, and that of curved surfaces too great; and that it is quite unfit for ascertaining the modifications of resistance arising from the figure of the body. The most prominent part of the prow changes the action of the fluid on the succeeding parts, rendering it totally different from what it would be were that part detached from the rest *, and exposed to the stream with the same obliquity.

These experiments of the French Academy are of importance, because they give us the impulses on plane surfaces with every obliquity. By referring to them, we may perceive the proper obliquity in many cases, and can tell what is the proper angle of the sail for producing the greatest impulse in the direction of the ship's course, &c.

It appears, from a comparison of these experiments, that the impulses and resistances are very nearly in the proportion of the surfaces. They appear, however, to increase somewhat faster than the surfaces. The Chev. Borda found that the resistance, with the same velocity, to a surface of

Surface.		Resistance.		
9 Inches	was	9	instead of	9
16 . . .	——	17.535		16
36 . . .	——	42.750		36
81 . . .	——	104.737		81

The deviations in these Experiments from the Theory appeared to increase with the surface, and is probably much greater in the extensive surfaces of sails, &c.

It has been observed by a learned and ingenious writer †, that "the Experiments of the French Academy, above described, are of great value, and may always be appealed to; but that there are circumstances in them which render them more complicated than is proper for a general theory, and which therefore limit the conclusions that might otherwise be drawn from them. The bodies were floating on the surface; and this circumstance necessarily produced the *plus* and *minus pressures*, or what the Academicians called the *Remou*, or accumulation on the fore part of the body and depression behind it. This resistance was measured with great difficulty and uncertainty, as was likewise the effect of adhesion, or friction of the water, which must also have been very considerable and very different in the different cases. It is necessary to consider these particulars as making part of the resistance in the most important practical cases, viz. the motion of ships; for here we see that its effect is very great; as it is well known that the speed, even of a coppered ship, is *greatly* increased by greasing her bottom, and thereby reducing the effect of this adhesion, &c.: and it is, therefore, to be concluded, that the form of these experiments was not so well suited as could be wished for the complete determination of the causes of resistance." This desideratum has however been much more completely attained by the Experiments of which we are now about to present an account, abstracted from the "Report of the Society instituted at London for the Improvement of Naval Architecture.

* This will more clearly appear hereafter.

† The Author of the Treatise on the Resistance of Fluids, in that invaluable work the Encyclopædia Britannica; to whom, with gratitude, we acknowledge ourselves considerably indebted.

2. EXPERIMENTS MADE UNDER THE DIRECTION OF THE SOCIETY INSTITUTED AT LONDON FOR THE IMPROVEMENT OF NAVAL ARCHITECTURE.

The Society for the Improvement of Naval Architecture having directed that Experiments should be made to ascertain the laws respecting Bodies moving through the water with different velocities; there were made, in consequence thereof, during the years 1793, 4, 5, 6, 7, and 8, several thousand experiments for this important purpose, by a more accurate apparatus than had ever before been used for experiments of this nature.

The results of the most important part of these Experiments were published by, and at the expence of, the Society in the year 1799, a short time before its much to be regretted dissolution; and, from the Report then published, the following abstract has been made. "The experiments will be found both curious and instructive. They explain many things which were before either not at all, or but very imperfectly, understood, and they ascertain new principles; but, what is most valuable, they clearly prove, that experiments can now be made, by means of proper models, so as to ascertain the comparative advantages, or disadvantages, arising from the form, either of the head end, or of the midship body, or of the stern end, of all kinds of navigable vessels."

The "Report" of the Society forms a thin volume in Royal Quarto; and contains, besides the letter press, ten copper plate prints; of which the first series, on four plates, contain the figures and sections of the various bodies made use of for the different experiments, with a Table shewing the motive powers required to overcome the resistances of the bodies when moving in still water,* at the rate of from one to eight nautical miles an hour; with a corresponding Table, shewing the velocities obtained by experiment with the several motive powers made use of; also the velocity, as brought into a regular series, and the mean power of the different velocities. The fifth plate exhibits the motive powers requisite to overcome the resistance arising from the friction of the water only against the several surfaces. The following plates exhibit an analysis of the total resistance of the different bodies respectively; and the two last contain plans of the machinery erected in Greenland Dock, Rotherhithe, for making the Experiments.

* The difference in the resistance of the same body, moving in a stream or current and moving in still water, may be readily conceived when we consider that, in the former case, the body sails on a sloping surface, not merely *along with the stream*, but down it, and will therefore go faster than the stream, because it is floating on an inclined plane; and if we examine it by the laws of hydrostatics, we shall find, that, besides its own tendency to *slide* down this inclined plane, there is an odds of hydrostatical pressure, which pushes it downwards. It will therefore go faster than the stream. This acceleration depends on the difference of pressure at the two ends, and will be more remarkable as the body is larger, and especially as it is longer. This may be distinctly observed: and it may also be observed that, when a number of bodies are thus floating down the stream, the largest and longest outstrip the rest. A log of wood floating down in this manner may be observed to make its way very fast among the chips and saw dust which float alongside of it.

Now, if a body be supported against the action of a stream, and the impulse be measured by the force employed to support it, it is obvious that part of this force is employed to act against that tendency which the body has to outstrip the stream: but this does not appear when we move a body with the velocity of the stream through still water having a horizontal surface.——*Encycl. Brit.*

Of these Tables, the one subjoined is a synopsis; and exhibits, at a single view, the general comparison or ratio of resistance of all the bodies made use of in the different experiments, both totally and as arising from the several specific causes. To this Table the plate marked D, at the end of this volume, is a necessary appendage, as it exhibits, in like manner, the figures and sections of all the solids, or bodies.

In Explanation of the Table, and of the Plate D, containing the figures of the different bodies, it is to be understood, that the bodies from figure 1 to figure 15, inclusive, are those by which Experiments were made in the year 1798: figure 17 to 25, those of the year 1797: and figure 26 to 34, those of 1796. The Experiments of the preceding years, unfortunately for Science, have never been published.

It is also to be understood, that the column of velocity per second, as given in the Table, is that obtained by the motive weight of 60lbs, and the different resistances and pressures taken when the respective bodies moved with a velocity equal to five nautical miles an hour.

It is likewise to be observed, that the first letter of the respective references to the different bodies denotes the head or foremost end of the body, as drawn through the water for experiment. For example, in describing the properties of the body APi, A signifies the head or foremost end; and, in like manner, describing those of the body iPA, which is the same figure reversed, i denotes the head or foremost end, when the body is moving in a contrary direction.

The quantity of surface and friction of water, shewn in the Table, is the surface and friction of the bottom and sides only; excepting those figures marked * which, of course, shew the total surface and friction. The former have been taken as shewing more exactly the effect of friction on the different bodies considered as ships, &c.

We would recommend, particularly to the younger part of our Readers, an attentive perusal of this Table, with a particular reference to all the figures, before they enter upon that of the subsequent part of the work; as we presume that it will tend considerably to open the mind, for the more ready comprehension of the particulars and principles developed hereafter.

TABLE SHEWING THE

RESULTS OF EXPERIMENTS

MADE UNDER THE DIRECTION OF THE

SOCIETY FOR THE IMPROVEMENT OF NAVAL ARCHITECTURE.

⁂ The Column of Capacity shews the comparative stability of the different bodies: The Velocity per Second is with a motive weight of 60 lbs.: The Total Resistance is equal to the weight giving a velocity at the rate of five miles an hour: The Friction is that on the bottom and sides only: The Resistance as a Ship, and the Pressures, correspond, of course, with the foregoing velocities.

	Capacity or Weight.	Velocity per Second. *Wt. 60 lbs.*	Total Resistance.	Friction of Water.		Resistance as a Ship.	Sum of Plus and Minus Pressures.	Minus Pressure only.	Plus pressure only.
				Surface.	Friction.				
	lbs. dec.	ft. dec.	lbs. dec.	ft. dec.	lbs. dec.	lbs. dec.	lbs. dec.	lbs. dec.	lbs. dec.
Conducting Body and Bar .... (fig. 1.)	....	9.264	48.69						
Long Friction Plank .... (fig. 2.)	....	7.419	30.329	50.0	30.329				
Short Friction Plank .... (fig. 3.)	....	7.906	20.731	4.0	20.731				
Body Ao .... (fig. 4.)	294.37	8.087	17.43	21.71	4.53	16.45	11.92	0.0	11.92
Body Aa .... (fig. 5.)	247.50	8.104	17.14	17.96	3.75	16.31	12.56	0.64	11.92
Body Ab .... (fig. 6.)	266.25	8.109	17.9	18.28	3.81	16.20	12.39	0.47	11.92
Body Ac .... (fig. 7.)	300.0	7.971	19.51	18.85	3.93	18.51	14.58	2.66	11.92
Body Ad .... (fig. 8.)	215.63	8.002	18.93	15.45	3.22	18.21	14.99	3.07	11.92
Body Ae .... (fig. 9.)	199.37	7.889	21.12	14.19	2.96	20.45	17.49	5.57	11.92
Body Af .... (fig. 10.)	181.87	7.468	29.95	12.91	2.69	29.34	26.65	14.73	11.92
Body Ag .... (fig. 11.)	193.13	7.662	25.38	13.19	2.75	24.74	21.99	10.07	11.92
Body Ah .... (fig. 12.)	179.37	7.837	22.8	12.44	2.60	21.48	18.88	6.96	11.92
Body Ai .... (fig. 13.)	155.0	7.631	26.25	10.48	2.19	25.73	23.54	11.62	11.92
Body bA .... (fig. 6.)	266.25	8.164	16.12	18.28	3.81	15.23	11.42	0.64	10.78
Body cA .... (fig. 7.)	300.0	8.048	18.12	18.85	3.93	17.12	13.19	0.64	12.55
Body dA .... (fig. 8.)	215.63	8.038	18.33	15.45	3.22	17.61	14.39	0.64	13.75
Body eA .... (fig. 9.)	199.37	7.916	20.58	14.19	2.96	19.91	16.95	0.64	16.31
Body fA .... (fig. 10.)	181.87	7.736	24.10	12.91	2.69	23.49	20.80	0.64	20.16
Body gA .... (fig. 11.)	193.13	8.122	16.87	13.19	2.75	16.23	13.48	0.64	12.84
Body hA .... (fig. 12.)	179.37	7.983	19.37	12.44	2.60	18.77	16.17	0.64	15.53
Body iA .... (fig. 13.)	155.0	6.326	61.99	10.48	2.19	61.47	59.28	0.64	58.64
Body Ho .... (fig. 14.)	226.25	7.960	19.78	16.19	3.38	19.02	15.64	0.00	15.64
Body Io .... (fig. 15.)	201.87	6.324	62.02	14.23	2.97	61.35	58.38	0.00	58.38
Conducting Body and Bar .... (fig. 16.)	....	9.613	48.06						
Body MN .... (fig. 17.)	....	7.514	26.13	8.96*	1.87				
.... *Reversed*	....	5.768	75.95						
Body R— A Cube .... (fig. 18.)	....	5.683	79.34	4.0*	0.83				
Square Iron Plane .... (fig. 19.)	....	5.634	80.76						
Round Iron Plane .... (fig. 20.)	....	5.650	80.64						
Cylinder .... (fig. 21.)	....	5.795	74.69	4.0*	0.83				
Cylinder and Semi-Globe ...... (fig. 22.)	....	6.057	56.04	6.0*	1.25				
.... *Reversed* (fig. 23.)	....	7.738	22.28						
Ditto with a Semi-Globe on each end	(fig. 24)	7.977	18.53	8.0*	1.67				
Globe or Sphere .... (fig. 25.)	....	7.578	25.24	4.0*	0.83				
Conducting Body and Bars............ (fig. 26.)	....	9.992	44.20						
Long Friction Plank .... (fig. 27.)	....	7.773	26.02						
Short Friction Plank .... (fig. 28.)	....	8.548	14.70						
Body APa or aPA .... (fig. 29.)	810.01	7.751	26.41	44.96	10.18	23.48	13.30	1.38	11.92
Body Ape .... (fig. 30.)	761.87	7.433	32.19	41.19	9.33	29.43	20.10	8.18	11.92
Body APk .... (fig. 31.)	805.62	7.467	31.64	43.31	9.81	28.40	18.59	6.67	11.92
Body APl. .... (fig. 32.)	833.12	7.490	31.06	44.21	10.01	27.72	17.71	5.79	11.92
Body APi .... (fig. 33.)		7.252	35.97	37.48	8.49	33.37	24.88	12.96	11.92
Body ePA .... (fig. 30.)	761.87	7.494	31.02	41.19	9.33	28.26	18.93	1.38	17.55
Body kPA .... (fig. 31.)	805.62	7.513	30.74	43.31	9.81	27.50	17.69	1.38	16.31
Body lPA. .... (fig. 32.)	833.12	7.544	30.13	44.21	10.01	26.79	16.78	1.38	15.40
Body iPA .... (fig. 33.)		6.054	70.28	37.48	8.49	67.68	59.19	1.38	57.81
Body lPi or iPl .... (fig. 34.)		5.830	79.16	30.0	6.79				

PRELIMINARY OBSERVATIONS ON THE EXPERIMENTS.

FOR the purpose of ascertaining the effect of resistance arising from the friction of the water, two bodies were procured, called the LONG FRICTION PLANK, and the SHORT FRICTION PLANK; these were of the same degree of smoothness, and also of the same breadth and thickness, and of the same form in every respect, except in length. Other bodies were also provided, some with a similar middle part and head end, but with differently formed stern ends, for the purpose of ascertaining the effect of the stern resistance and the *minus pressure;* and some with a similar middle part and stern end, but with differently formed head ends, for ascertaining the effect of the head resistance and the *plus pressure.* All these bodies, planed smooth and painted white, were of the form and dimensions represented in the engraving; and, when used for experiment, were respectively immersed, by means of the conductor, and its bar or bars, to the medium depth of six feet under the surface of the water; and, when so immersed, the conductor swam with its top, or horizontal upper surface, exactly one inch above the upper surface of the water.

Having, by means of a set of weights, * or motive powers, obtained by experiment a set of velocities most accurately taken, it became necessary to examine and compare the experimented velocities and resistances, in order to determine the law regulating their respective velocities; and this was done by the following method.

Assuming, by way of example, a set of experiments containing a great number of experimented resistances, made by the conductor, its bar, and the long friction plank (fig. 1. as represented on the plate) it became necessary first to try, in what powers of the velocity the several motive powers, or resistances, were to be found, by comparing together every two experiments, as in the following series: that is, first the 120lb. with every weight or resistance less than it; then the 96lb. with every weight or resistance less than it; and so on, till every combination of two's had been made.

Motive Powers in Pounds	12	24	36	48	60	72	96	120
Velocities per second in feet and decimal parts, according to Experiment	3.408	4.888	5.847	6.668	7.420	8.161	9.327	10.310

This was done by a correct Theorem; and the differences, amounting in number to 28, were correctly taken. These were various, but the variation small, and preponderating either way, which indicated that the law of resistance is constant or regular, and that these irregularities in the value of the differences proceeded from small irregularities in the Experiments themselves.

An Exponent, expressing the mean difference, or velocity, was therefore deduced from the sum of the 28 differences found; by means of which, the experimented numbers were reduced

* The smallest weight used as a motive power was of 12lbs.; the rest increased by 12lbs. each to 72lbs. Then 96lb. and 120lb.

to a regular series, and being thus reduced they appeared as follows, and are to be considered as the correct or regular series of experiments.

Motive Powers in Pounds	12	24	36	48	60	72	96	120
Velocities in regular Series	Ft. dec. 3.455	Ft. dec. 4.801	Ft. dec. 5.821	Ft. dec. 6.673	Ft. dec. 7.419	Ft. dec. 8.090	Ft. dec. 9.273	Ft. dec. 10.310

The resistance to different *proposed velocities* were again correctly computed by another theorem*, according to the velocity in feet per second, from one to eight geographic or nautical miles an hour; and, these being determined, the next object was, to ascertain the Resistance arising from the friction of the water only against the several surfaces of the different bodies respectively.

By inspecting the form and dimensions of the friction planks, (fig. 2 and 3,) used in the year 1798, as given in the plate, it will be seen that the long friction plank was exactly 12 feet longer than the short friction plank; they were of the same degree of smoothness, and were exactly similar in the form and dimensions of their head ends and stern ends; that is to say, they were similar in every respect except in length. Whence it is evident, that, whatever difference arises between the resistance of the two planks, such difference must be the resistance arising from the friction alone of the water against 46 square feet of surface, which is the surface contained in the long friction plank more than in the shorter one.

The difference between the resistance of the two friction planks (which is equal to the friction of the water against 46 square feet of surface) having been ascertained, the resistance arising from friction of the water on the surfaces of the other bodies was allowed for by this proportion, that is to say, according to the proportion which those surfaces bear respectively to 46 square feet.

ON THE RESISTANCE SUSTAINED BY THE DIFFERENT BODIES WHEN CONSIDERED AS NAVIGABLE VESSELS, &c. &c.

The bodies made use of for the different experiments were severally immersed to the medium depth of six feet, as before mentioned, by means of the bar, or bars, affixed to the conductor. Consequently, in order to make comparisons with these bodies, considering them as ships, or navigable vessels, it was necessary to deduct the friction against the top surface from the total resistance. Such deductions were accordingly made, and the motive powers requisite to overcome the resistance of the bottom and sides only, as navigable vessels, were thereby ascertained.

In the experiments of the year 1798, the bodies Ao, Aa, &c. to Ai, (Figures 4 to 13,) were constructed for the purpose of ascertaining the advantages or disadvantages arising from their

* These Theorems are given in the Report.

differently formed stern ends. Now, by inspecting the resistances of the bodies Ao (fig. 4.) and Aa, fig. 5. (as Ships) as shewn in the preceding Table, it will be seen, that the resistance of the body Aa is a little less than the resistance of the body Ao; and also, that the resistance of the body Ah, (fig. 12.) reversed as hA, is a little less than the resistance of the body Ho (fig. 14.); which curious circumstance arises in each case from the stern end o, having a greater surface for friction than the stern end a. Whence it is evident, that the resistance arising from the friction against the stern end o, is greater than the friction and minus pressure together of the stern end a.

Another curious circumstance is, that the resistance of the body Ab, fig. 6. (as a Ship) was found to be a little less in the velocities from five miles per hour downwards than the resistance of Aa, but in the higher velocities the body Aa has the least resistance.

	1 mile	2 miles	3 miles	4 miles	5 miles	6 miles	7 miles	8 miles
Aa's Resistance	0.66	2.70	6.03	10.60	16.31	25.15	31.02	39.88
Ab's Resistance	0.62	2.58	5.85	10.40	16.20	25.21	31.38	40.69

This crossing is occasioned by the law of the stern resistance of the stern end b, increasing in a greater ratio than the stern resistance of the stern end a: and which probably arises from the angular part of the stern end b, (that is from s to b) being more obtuse than that of the stern end a.

And, with respect to the bodies Ac, Ad, &c. to Ai, it will be seen, that they have all greater resistances than either of the aforesaid bodies Ao, Aa, or Ab: which are disadvantages that evidently arise out of the form of the stern end of the said bodies respectively; and of which the stern end f, of the body Af (fig. 10.), has the greatest disadvantage, or is the worst stern end of all.

The bodies Aa, Ab, Ac, &c. to Ai, (fig. 5 to 13.) reversed, were made use of for the purpose of ascertaining the advantages or disadvantages arising from their several differently formed head ends; and those different advantages or disadvantages will be seen by an inspection of the table.

In the investigation of this subject, that is, considering the different bodies as representing ships, it must be noticed, that they have different magnitudes, and consequently different degrees of stability, or stiffness to carry sail; and also, that the relation which the resistance bears to the capacity, or the relation which the resistance bears to the *vis insita* force, or power of going forward, and the momentum, will be different in each body.

Taking the subject in this point of view, it of course becomes necessary to ascertain the relation which the resistance bears to the capacity, and also the comparative degrees of stability of the respective bodies; whence we shall be able to draw conclusions applicable to practice.

And, as the bodies are of the same form and dimensions in their midship section, and only differ in length, and in the form of their head ends and stern ends; therefore their comparative stability will be nearly in proportion to the capacities of the different bodies respectively. Whence it is readily conceived that the comparative power, or quantity of sail, which the different bodies are capable of sustaining, will also be nearly in proportion to their respective capacities.

And the capacities, when considered as ships, or their weight as a column of water, are found to be as follow :

lbs. dec.	lbs. dec.	lbs. dec.	lbs. dec.
Ao = 294.37	Ac = 300.00	Af = 181.87	Ai = 155.00
Aa = 247.50	Ad = 215.63	Ag = 193.13	Ho = 226.25
Ab = 266.25	Ae = 199.37	Ah = 179.37	Io = 201.87

Then, by taking the resistances, say at the velocity of five miles an hour, as shewn in the foregoing Table, and placing them as numerators; and also by placing the capacities, or weights, as above, under their correspondent resistances as denominators; the numbers so placed will represent the relation which the resistance bears to the capacity; and also the relation which the resistance bears to the *vis insita* force, or power of going forward (or to the momentum) all which relations are as follow :

		lb. dec.			lbs. dec.			lbs. dec.			lbs. dec.
Ao	Resistance =	16.45	cA	Resistance =	17.12	fA	Resistance =	23.49	iA	Resistance =	61.47
	Capacity =	294.37		Capacity =	300.00		Capacity =	181.87		Capacity =	155.00
Aa	Resistance =	16.31	dA	Resistance =	17.61	gA	Resistance =	16.23	Ho	Resistance =	19.02
	Capacity =	247.50		Capacity =	215.63		Capacity =	193.13		Capacity =	226.25
bA	Resistance =	15.23	eA	Resistance =	19.91	hA	Resistance =	18.77	Io	Resistance =	61.35
	Capacity =	266.25		Capacity =	199.37		Capacity =	179.37		Capacity =	201.87

For the sake of comparing the above numbers more readily, they have been considered as fractions, and reduced to their lowest terms, whence the relation which the resistance bears to the capacity, or the capacity to the resistance, &c. will be as follows :

	Ao	Aa	bA	cA	dA	eA	fA	gA	hA	iA	Ho	Io
Resistance	1	1	1	1	1	1	1	1	1	1	1	1
Capacity	17.895	15.175	17.482	17.523	12.244	10.014	7.743	11.899	9.559	2.522	11.895	3.291

Now, it appears, by an inspection of these numbers, that the relation which the resistance bears to the capacity (or to the stability, or to the vis insita force) is nearly the same in the bodies Ao, bA, and cA; that is to say, if their respective resistances be equal to 1, then the capacity or stability, or vis insita force of Ao, is 17.895, of bA, 17.482, and of cA, 17.523: hence it appears, that the body Ao has the greatest advantage, and the body cA the next greatest advantage. But, supposing these bodies to be ships in motion at sea, then it may fairly be inferred that the body cA would be the worst of the three bodies. Because the head end of cA would not meet with so much lateral resistance to keep the body to windward; and it would meet with more resistance in its pitching motion than either of the bodies Ao or Ba.

It has been deemed requisite to say thus much respecting the method of comparing the results of the different experiments with the bodies, in order to prevent such as may not have had an opportunity of considering the subject fully, from drawing conclusions by comparing the resistances only; and, for this reason, we proceed to make some farther comparisons by way of illustration. We will therefore compare the resistance of the bodies cA and gA as found in the Table; whence it appears that the resistances are nearly the same: but, on considering these bodies as ships at sea, and impelled forwards by the force of the wind on their sails, it will be found, by assuming the resistance of the two bodies, respectively, as 1, that the capacity and stability, or comparative power to carry sail, as also the vis insita force of the long body cA would be 17.523, and of the short body gA 11.899.

It will then be evident that the long body cA has not only the advantage of being capable of bearing about one third more sail than the short body gA; but it also has an advantage arising from its great vis insita force, or the power of overcoming such resistance as may be occasioned by the undulation of the water (or otherwise) to its direct motion.

It is also to be considered that the pitching motion is not so quick, nor the areas of vibration in general so great, in long* ships as in short ships; therefore the short ship has not only a disadvantage (as compared with a long ship) arising from the smallness of its vis insita force; but also another disadvantage, which is, that its vis insita force is destroyed in a much greater degree by a pitching motion than the vis insita force of the longest ship possibly can be, by its pitching motion.

Again, it is to be considered, that the power of the wind, by which ships obtain their velocity, is variable in its force and direction, in almost every instant of time. Consequently, the longer ship, which has the greatest vis insita force, will have the advantage as compared with the short ship, of moving with more uniformity in its velocity, and more steadiness in its direct motion; and will, of course, thereby feel the power of the wind upon its sails in a greater comparative degree, than the short ship can, upon its sails.

Upon reference to the figures in the plate, it will be seen that the bodies aPA, ePA, kPA, lPA, (*fig.* 29 *to* 32.) were respectively constructed with differently formed head ends, but with the same middle part and stern end.

Now, for the sake of comparison, we shall place the resistance of these bodies, as ships, moving with the velocity of five miles an hour as numerators; and the capacities or weights of the bodies under their correspondent resistances as denominators; and as follows:

		lbs.								
aPA	Resistance =	23.48	ePA	Resistance =	28.26	kPA	Resistance = 27.50	lPA	Resistance =	26.79
	Capacity =	810.01		Capacity =	761.87		Capacity = 805.62		Capacity =	833.12

By reducing the above numbers to their lowest terms, the relation which the resistance bears to the capacity, or the capacity to the resistance will be as follows:

aPA	ePA	kPA	lPA
1	1	1	1
34.498	26.959	29.295	31.098

* This comparison refers to ships of similar form and dimensions in the head end and stern end, and having the same form in the midship section; but of different lengths by means of midship body. Or to the advantages and disadvantages in ships that have been lengthened, as compared before and after they are lengthened in the midship body.

Now the body aPA is exactly of the same form and dimensions in its head end, and stern end, and in every respect, except in the length of its middle part, as the body Aa. But by comparing the relation which the resistance bears to the capacity, &c. of the body Aa, as previously found, with the relation which the resistance bears to the capacity, &c. of the body aPA, as found above, it appears that if the resistance of these bodies Aa and aPA be respectively equal to one, that then the capacity and comparative stability, and vis insita force, of the short body Aa would be 15.175; and of the long body aPA, 34.498. Whence a very considerable advantage appears in favour of the long body, which arises from the difference in the length only *.

The Isosceles angular head end e, of the body ePA, and the projecting angular head end k, of the body kPA, were constructed so as to have the same angle of inclination, and the same area of oblique surface in their respective head ends; that is to say, that the hypothenuse or oblique surface of the head end k is equal to the sum of the two sides, or oblique surface of the head end e.

The oblique surface of the head end k, was made to incline upwards for the purpose of ascertaining the advantage or disadvantage which might arise from its resistance in such position, as compared with the resistance of the head end e, according to its position.

Now, by comparing the relation which the resistance bears to the capacity, &c. of these bodies, as already given, it appears, that, if the resistance of the bodies ePA and kPA be respectively equal to 1, then the capacity, or stability, or vis insita force, of ePA, is 26.959, and of kPA 29.295, which shews an advantage in favour of the body kPA †, that is of some moment, and which advantage arises from the form of its head end only. *(See the Table.)*

The compound projecting angular head l, of the body lPA, (*fig.* 32.) was constructed with the same angle of inclination upwards, in the direction of y r (see the plate) as the head end k, of the body kPA, and the horizontal section of its pointed end is an equilateral triangle; this head end was constructed for the purpose of ascertaining the advantage or disadvantage which might arise from such form as compared with the head end k, of the body kPA.

Now, by comparing the relation which the resistance bears to the capacity, &c. of the said bodies, as already given, it appears, that if the resistance of the bodies kPA and lPA be respectively equal to 1, then the capacity, or stability, or vis insita force, of the body kPA is 29.295; and of the body lPA, 31.098, which gives an advantage in favour of the body lPA, arising from the form of its head end only.

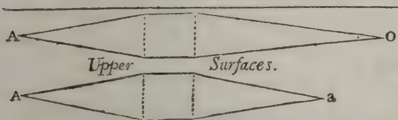
* Comparisons may, in like manner, be made with other bodies; and it is a method of reasoning which applies to all kinds of vessels moved by sails. But, in applying it to ships or models of differently formed midship sections, and of different breadths or depths, it is of course then necessary to ascertain the stability of each body, according to its particular form and the height of its centre of gravity, &c.

† This advantage is supposed to arise from the particles of water which strike the oblique surface of the head end k, being deflected downwards under the body, by which means the head end is impelled upwards.

ON FINDING THE PLUS AND MINUS PRESSURES, TOGETHER AND SEPARATELY, OF THE DIFFERENT BODIES; WITH OBSERVATIONS ON THE LAW OF THE PLUS PRESSURE AGAINST DIRECT AND OBLIQUE SURFACES.

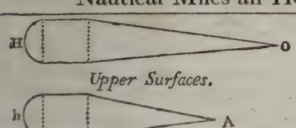
THE motive powers requisite to overcome the plus and minus pressures (together) of the different bodies respectively, may be found in two ways: that is, either by deducting the friction of the water which takes place against the total surface of the different bodies from the total resistance, as given in the table; then the remaining numbers will be equal to the motive powers requisite to overcome the plus and minus pressures, together, of the different bodies, respectively. Or, by deducting the friction against the sides and bottom surface from the resistance, as ships, given in the Table, the remaining numbers will likewise be equal to the motive powers requisite to overcome the plus and minus pressures, together, of the different bodies. Of these methods the latter was used for the requisite computations in the course of making the experiments here explained.

In order to shew how the plus and minus pressures were separated, we shall now compare the resistance of the bodies Ao and Aa as found by experiment, which are as follows:

Nautical Miles an Hour	1	2	3	4	5	6	7	8
	Motive powers in pounds and decimal parts.							
	℔. 0.73	℔. 2.94	℔. 6.52	℔. 11.38	℔. 17.43	℔. 24.62	℔. 32.85	℔. 42.07
	0.71	2.87	6.38	11.17	17.14	24.26	32.42	41.59

Now, by inspecting the form and dimensions of these bodies, as shewn in the plate, it will be seen that the head end and middle part of them are exactly similar, and that they differ only in the form and dimension of their stern ends. Consequently, whatever difference arises between the resistances, as found above, must be occasioned by the form and dimensions of the stern ends only. Then, upon inspection of the foregoing numbers, it appears, that the body Ao, meets with a little more resistance than Aa; which evidently shews that the stern resistance of the body Ao, is a little more than the stern resistance of Aa.

And, by comparing the total resistance of the body Ho with that of hA as follows:

Nautical Miles an Hour	1	2	3	4	5	6	7	8
	Motive Powers in Pounds and Decimal Parts.							
	0.78	3.20	7.21	12.62	19.78	28.25	38.10	49.28
	0.76	3.13	7.06	12.55	19.37	27.67	37.31	48.26

In this comparison the same result as the former is proved, namely, that the stern resistance of Ho is a little more than that of hA. *This fact is curious and interesting.*

But, when the friction against the several surfaces of the bodies Ao and Aa is deducted, then, by comparing the plus and minus pressures, (together) of Ao, with the plus and minus pressure together of Aa, they are as follows:

Nautical Miles an Hour	1	2	3	4	5	6	7	8
Plus and Minus Pressure (together) of Ao	0.40	1.79	4.19	7.57	11.92	17.25	23.50	30.67
Plus and Minus Pressure (together) of Aa	0.44	1.92	4.46	8.01	12.56	18.14	24.66	32.13

Now, according to the above numbers, it appears, that the plus and minus pressures together, of the body Ao, is a little less than the plus and minus pressures together of Aa.

But, as the plus pressure against the head end A, must be the same in both bodies, and as the friction is wholly taken away, therefore the difference between the numbers must be the difference of the minus pressure only; which difference being very small, when compared with the great difference in the length of the stern ends o and a, it may fairly be inferred, that the stern end o has no minus pressure; or, if any, that it is so little as to be of no moment in this investigation.

Then, taking the minus pressure of the stern end o, of the body Ao, to be equal to 0,000 lb. at any velocity, from 1 to 8 nautical miles per hour, the plus pressures and minus pressures to all the bodies may be thus separately found.

ON THE LAW OF THE PLUS PRESSURE AGAINST DIRECT AND OBLIQUE SURFACES.

If we take the plus pressure of the flat head end I, of the body Io, (*fig.* 15.) at the velocity of 8 miles an hour, which is found equal to 148,25 lb. and reduce it according to the sines of the Angles of Incidence of the different angular head ends a d e f (fig. 5, 8, 9, 10,); such plus pressures will come out as shewn in this table.

And, by comparing the said Plus Pressure with the Plus Pressure as deduced from experiment, and shewn here, it must be evident, that *the plus pressures, as deduced from experiment, do not follow the law of the sine of the angle of incidence, nor any regular law that has yet been discovered.*

Angle of Incidence.	Plus Pressure by Experiment.	Plus Pressure by Theory, Line of Angle of Incidence to Radius 148.25 lb.
° ′ ″	lb.	lb.
a = 9.44.10	= 30.67	. . . . 24.71
d = 14.28.40	. . . 35.34	. . . . 37.06
e = 19.28.15	. . . 41.71	. . . . 49.42
f = 30. 0. 0	. . . 51.44	. . . . 74.13

TABLES SHEWING THE RATE (OR INDEX OF THE POWER) OF THE VELOCITY OF THE DIFFERENT BODIES, WITH OBSERVATIONS ON THE SAME.

I. INDEXES OF THE POWER OF THE VELOCITY BY WHICH THE TOTAL RESISTANCE OF THE DIFFERENT BODIES WAS FOUND TO INCREASE OR DECREASE.

	Nautical Miles an Hour * =	2	3	4	5	6	7	8
		Index of the Power of the Velocity.						
Bodies used in the Experiments of the Year 1798.	Ao (*fig.* 4.)	2.010	1.993	1.981	1.971	1.964	1.956	1.950
	Aa (*fig.* 5.)	2.015	1.999	1.988	1.978	1.971	1.964	1.958
	Ab (*fig.* 6.)	2.042	2.030	2.020	2.013	2.007	2.001	1.996
	Ac (*fig.* 7.)	2.000	1.983	1.971	1.962	1.954	1.946	1.940
	Ad (*fig.* 8.)	1.987	1.973	1.961	1.951	1.942	1.934	1.927
	Ae (*fig.* 9.)	2.034	2.019	2.011	2.003	1.998	1.992	1.987
	Af (*fig.* 10.)	2.053	2.045	2.041	2.036	2.033	2.030	2.027
	Ag (*fig.* 11.)	1.965	1.950	1.938	1.928	1.919	1.911	1.904
	Ah (*fig.* 12.)	2.020	2.006	1.996	1.988	1.982	1.976	1.971
	Ai (*fig.* 13.)	2.027	2.014	2.006	2.000	1.995	1.990	1.985
	bA (*fig.* 6.)	2.040	2.030	2.021	2.014	2.009	2.004	1.999
	cA (*fig.* 7.)	2.005	1.991	1.980	1.971	1.963	1.956	1.950
	dA (*fig.* 8.)	2.014	2.001	1.993	1.986	1.980	1.974	1.969
	eA (*fig.* 9.)	2.026	2.012	2.003	1.995	1.989	1.983	1.977
	fA (*fig.* 10.)	2.019	2.010	2.002	1.996	1.991	1.986	1.981
	gA (*fig.* 11.)	2.038	2.027	2.020	2.014	2.008	2.004	1.999
	hA (*fig.* 12.)	2.042	2.029	2.019	2.012	2.006	2.001	1.996
	Ho (*fig.* 14.)	2.037	2.024	2.016	2.009	2.003	1.998	1.994
	iA (*fig.* 13.)	2.018	2.011	2.006	2.002	1.999	1.996	1.994
	Io (*fig.* 15.)	2.012	2.006	2.002	1.998	1.995	1.992	1.989
Bodies used in the Experiments of the Year 1796.	APa (*fig.* 29.)	1.822	1.818	1.817	1.816	1.816	1.815	1.815
	ePA (*fig.* 30.)	1.839	1.833	1.831	1.831	1.830	1.829	1.829
	kPa (*fig.* 31.)	1.853	1.849	1.849	1.848	1.848	1.848	1.847
	lPa (*fig.* 32.)	1.847	1.842	1.841	1.840	1.839	1.838	1.838
	iPa (*fig.* 33.)	1.954	1.952	1.952	1.951	1.951	1.951	1.951
	APe (*fig.* 30.)	1.833	1.832	1.831	1.831	1.881	1.830	1.830
	APk (*fig.* 31.)	1.861	1.856	1.855	1.854	1.854	1.853	1.853
	APl (*fig.* 32.)	1.818	1.817	1.817	1.816	1.816	1.815	1.815
	APi (*fig.* 33.)	1.873	1.869	1.868	1.868	1.867	1.867	1.867

* This Table was formed by comparing the resistance of the different bodies at the velocity of one mile an hour with the resistance at each of the following velocities up to eight miles an hour, by the method specified in a foregoing section.

By an inspection of it, it will appear, that, the power of the velocity of the bodies used in the Experiments of the year 1798, at two miles an hour, is in general *a little above the duplicate ratio,* or square of the velocity ; but that the ratio gradually decreases as the velocity increases, and becomes a little *less* than the duplicate ratio at the velocity of eight miles an hour ; excepting with the body Af, which is always greater than the duplicate ratio.

With respect to the bodies used in the year 1796, it also appears, by inspecting the numbers in the Table, that the power of the velocity with these bodies is considerably less than that of the bodies used in 1798, and is always less than the duplicate ratio. This difference in the power of the velocity of 1798 and 1796 arises from the bodies used in 1796 having a much greater surface for friction than the bodies used in 1798, and also, because the friction always increases in a much less ratio than the duplicate ratio, as shewn by the following Table. So that the friction of the bodies used in the year 1796, forms a greater proportional part of their total resistance, than it does in the bodies used in 1798.

II. INDEXES OF THE POWER OF THE VELOCITY BY WHICH THE RESISTANCE ARISING FROM THE FRICTION OF THE WATER INCREASES OR DECREASES.

	Nautical Miles an Hour =	2	3	4	5	6	7	8
		Indexes of the Power of the Velocity.						
This Table was formed by comparing the friction on 46 square feet of surface, as found by the Experiments of 1798; and also by comparing the friction on 50 square feet of surface, as found by the experiments of 1796.	From the friction as found by the Experiments of 1798..............	1.823	1.800	1.780	1.762	1.745	1.729	1.713
	From the friction as found by those of 1796............................	1.753	1.741	1.734	1.729	1.726	1.723	1.720

III. INDEXES OF THE POWER OF THE VELOCITY BY WHICH THE PLUS PRESSURE OF THE DIFFERENT BODIES INCREASES OR DECREASES.

	Nautical Miles an Hour =		2	3	4	5	6	7	8
			Indexes of the Power of the Velocity.						
This Table was formed by comparing the plus pressures of the different bodies, according to the method heretofore specified. By an Inspection of the numbers it will appear that the power of the velocity of the plus pressure is always a little above the duplicate ratio.	Ends (as Head Ends) of the Bodies used in the year 1798.	A	2.162	2.138	2.121	2.109	2.101	2.093	2.087
		b	2.219	2.201	2.192	2.184	2.179	2.173	2.168
		c	2.136	2.119	2.106	2.096	2.088	2.080	2.074
		d	2.116	2.098	2.092	2.086	2.078	2.072	2.067
		e	2.108	2.090	2.081	2.073	2.067	2.061	2.056
		f	2.091	2.078	2.069	2.062	2.056	2.051	2.046
		g	2.162	2.140	2.132	2.125	2.118	2.113	2.109
		H	2.142	2.120	2.107	2.099	2.092	2.087	2.082
		I	2.036	2.029	2.024	2.020	2.017	2.014	2.012
	Ends (as Head Ends) of the Bodies used in the year 1796.	A	2.162	2.138	2.121	2.109	2.101	2.093	2.087
		e	2.068	2.050	2.038	2.029	2.023	2.019	2.014
		k	2.155	2.132	2.118	2.106	2.098	2.092	2.086
		l	2.158	2.135	2.119	2.105	2.096	2.090	2.084
		i	2.068	2.059	2.053	2.048	2.045	2.043	2.041

IV. INDEXES OF THE POWER OF THE VELOCITY BY WHICH THE MINUS PRESSURE OF THE DIFFERENT BODIES INCREASES OR DECREASES.

	Nautical Miles an Hour =		2	3	4	5	6	7	8
			Indexes of the Power of the Velocity.						
This Table was formed by comparing he minus pressures of the different bodies according to the method heretofore described.	Stern End of the Bodies used in the year 1798.	a	1.701	1.738	1.730	1.723	1.731	1.730	1.730
		b	——	——	5.416	4.823	4.426	4.205	4.053
		c	1.837	1.834	1.834	1.830	1.820	1.813	1.806
		d	1.751	1.744	1.740	1.729	1.714	1.698	1.682
		e	1.968	1.964	1.976	1.980	1.982	1.982	1.982
		f	2.060	2.061	2.065	2.066	2.066	2.066	2.066
		g	1.860	1.841	1.828	1.818	1.806	1.795	1.785
		h	1.953	1.939	1.936	1.933	1.930	1.927	1.924
		i	1.978	1.969	1.969	1.967	1.965	1.963	1.961

By inspecting the number in the last Table it will appear that the power of the velocity of the minus pressure is various, and is always less than the duplicate ratio, except with the stern ends b and f, with which it is always greater than the duplicate ratio. Now, as the minus pressure of the stern end b is very little, only 0.24 lb. at the velocity of 3 miles an hour, and 2.13 lb. at 8 miles an hour, therefore the great comparative ratio by which the minus pressure increases, might partly arise from the form of the stern end, and partly from a small error in the experiments with the body Ab at the slow velocities, for an error of one-twelfth part of a pound in the resistance at the velocity of one mile an hour, would produce the effect in the law of the minus pressure as shewn in the Table.

OBSERVATIONS RESPECTING THE COMPARATIVE RESISTANCE OF THE ISOSCELES TRIANGLE, THE CUBE, THE SQUARE PLANE, THE ROUND PLANE, THE CYLINDER, THE GLOBE, &C.

THE Isosceles triangle MN (*fig.* 17.), which was used in the experiments of the year 1797, was exactly of the same form and dimensions as the angular head A of the body Ai, &c. in the experiments of the year 1798. (*See the Plate.*) Hence the plus pressure of this triangle is conceived to be the same as the plus pressure of the head end A in those figures; and the minus pressure is conceived to be nearly the same as the minus pressure of the stern end i. The friction as given in the Table. Now, for the sake of comparison, we will compare the sum of these resistances with the total resistance of the triangle as found by actual Experiment.

Nautical Miles an Hour	1	2	3	4	5	6	7	8
	Motive Powers in Pounds and Decimal Parts.							
Plus Pressure of A by Experiments	0.40	1.79	4.19	7.57	11.92	17.25	23.50	30.67
Minus Pressure of i by Experiments	0.49	1.93	4.26	7.51	11.62	16.57	22.35	28.92
Friction on M	0.11	0.39	0.79	1.29	1.87	2.50	3.17	3.87
Sum for the Total Resistance of M	1.00	4.11	9.24	16.37	25.41	36.32	49.02	63.46
Total Resistance of M, as found by actual Experiment	1.12	4.39	9.70	16.96	26.13	37.15	49.99	64.61

It appears from these numbers that the total resistance of the triangle MN, as found by actual experiment in 1797, is a little more than the total resistance as deduced from the experiments of 1798.

This small difference* is conceived to arise from the effect which the deflection of the water has on the minus pressure of the triangle M; for the water which is deflected by the oblique surface or sides of the triangle, acts with its deflected force, to prevent the surrounding water from filling up the void at the base or stern end of the body.

Whereas in the body Ai (*fig.* 13.) the water which is deflected by its oblique surface has time to lose the effect of deflection, and becomes parallel to the sides of the moving body before it arrives at its stern end: therefore the surrounding water is not impeded by deflection from acting with its full force and pressure to fill up the void behind.

The Cube, the Square Iron Plane, the Round Iron Plane, and Cylinder (*fig.* 18, 19, 20, 21,) were constructed with the same area of flat surface in the head and stern end, namely, one square foot of surface in each, for the purpose of ascertaining the advantages or disadvantages arising from such form with respect to the effect of the deflection of the water.

It appears from the experiments that the cube has less resistance than the square plane; and that the cylinder has less resistance than the round plane; these differences evidently arise from the water which is deflected by the front of the square plane (and the same with respect to the round plane, *fig.* 20.) acting with its whole deflected force, to prevent the surrounding water from filling up the void behind.

* The effect which the deflection has on the minus pressure of the triangle M, cannot be much, because its angular form is very acute.

Whereas in the cube* *(fig. 18.)* and cylinder *(fig. 21.)* the water which is deflected by the front of these bodies has time to lose a great part of its deflected force before it arrives at the stern end of the moving bodies, and therefore the surrounding water is but little impeded by deflection from filling up the void behind them.

The Experiments with the cylinder, with a semi-globe for the stern end *(fig. 22.)*, and reversed with a semi-globe for the head end *(fig. 23.)*, serve to shew the advantages and disadvantages arising from such forms, as shewn by the Table.

The Cylinder with a semi-globe both for head-end and stern-end *(fig. 24.)*, and the Globe *(fig. 25)*, were constructed for the particular purpose of ascertaining the advantages or disadvantages arising from such forms with respect to the effect of the deflection of the water.

And, upon comparing the resistance of these, it was found that the resistance of the cylinder with a semi-globe on each end *(fig. 24.)*, when moving at the rate of 8 miles an hour, is 46.29 ℔. and that the resistance of the Globe with the same velocity is 64.87 ℔.; whence it appears, that there is a considerable advantage in favour of the former. This advantage evidently arises from its minus pressure being very little, if at all, affected by the deflection of the water from its head-end; because the water which is deflected by the circular surface of its head-end has sufficient time to lose the effect of deflection, and becomes parallel to the sides of the moving body, before it arrived at the stern-end, and therefore the surrounding water is not impeded by deflection from acting with its full force and pressure (or nearly so) to fill up the void behind.

Whereas in the Globe, the water which is deflected by the circular surface of its head-end, acts with great force to prevent the surrounding water from filling up the void behind.

So that the comparative effect, arising from the deflection alone upon the minus pressure of the globe, appeared to be 18.58 ℔. more than upon the cylindric body *(fig. 24.)*, which is very considerable.

COMPARISONS RELATIVE TO THE ACCURACY OF THE EXPERIMENTS.

The parallelopiped, or body IPi *(fig. 34.)* was constructed for the purpose of making comparisons, or for verification, with respect to the accuracy of the Experiments, as shewn in the following example:

Nautical Miles an Hour	1	2	3	4	5	6	7	8
	Motive Powers in Pounds and Decimal Parts.							
Plus Pressure of the body iPA *(fig. 33.)*	2.14	8.97	20.54	36.83	57.81	83.51	113.94	148.98
Minus Pressure i of the body APi (fig. 33.)	0.69	2.42	5.04	8.56	12.96	18.16	24.24	31.15
Friction on Total Surface of IPi (fig. 34.)	0.56	1.89	3.79	6.20	9.06	12.34	16.01	20.03
Sum for the Total Resistance of IPi	3.39	13.28	29.37	51.59	79.83	114.01	154.19	200.16
Total Resistance of IPi, by actual Experiment.	3.39	13.19	29.14	51.16	79.16	113.08	152.86	198.47

* It is supposed that the difference which appears between the resistance of the cube and the cylinder arose from the impracticability of drawing the cube through the water with the same degree of steadiness as the cylinder; and the Experimentalists have observed, that they found great difficulty in drawing these short bodies, with flat head ends and flat stern ends, through the water with the same degree of steadiness as the other bodies, but the cube was the worst of all.

By inspecting the foregoing numbers it will appear that the resistance of the body IPi, as deduced from the experiments, with iPA or APi, comes out nearly the same as the resistance found, by actual experiment with IPi, and that the difference does not amount to one 120th part of the resistance; which is a strong proof of the accuracy of the experiments with the bodies iPA or APi and IPi, and which is farther proved by comparing the plus pressure of the flat end i *(fig. 13.)*, as found by the experiments of 1798, with the plus pressure of the flat end i *(fig. 34.)*, as found by the experiments of 1796, as subjoined.

Nautical Miles an Hour	1	2	3	4	5	6	7	8
	Motive Powers in Pounds and Decimal Parts.							
Plus Pressure of i with the body iA (fig. 13.) ..	2.27	9.31	21.08	37.55	58.64	84.27	114.38	148.92
Plus Pressure of i with the body iAP (fig. 34.) .	2.14	8.99	20.54	36.83	57.81	83.51	113.94	148.98

COMPARATIVE OBSERVATIONS ON THE RESISTANCE ARISING FROM THE ADHESION OR FRICTION OF THE WATER.

For the sake of explaining the different effects which have been found with respect to friction, it is necessary to observe, that the friction planks and other bodies, that were used in the Experiments of the year 1796, were planed smooth and painted; and that they were immersed a sufficient time in the water, so as to be pretty much water soaken (but clean from slime or dirt) before the experiments were made.

And also, that the respective friction planks and other bodies, that were used in the Experiments of the year 1798, were planed smooth and painted, *but were not water soaken;* and also clean from slime or dirt.

Whence it is evident that the Experiments of the year 1798 were not made precisely under the same circumstances as the former; that is, so far as relates to the resistance arising from the friction; for it is to be noticed, that when bodies have been immersed some time in the water, so as to be pretty much water soaken, then the fibres of the wood start, and the surface becomes rougher than when such bodies were first immersed; therefore, the resistance arising from the friction will be greater against the bodies that have been water soaken, as in the friction found by the Experiments of 1796; and which is shewn to be the case by the following comparison.

Nautical Miles an Hour	1	2	3	4	5	6	7	8
	Motive Powers in Pounds and Decimal Parts.							
Friction against one square foot of surface by Experiments in 1796	0.014	0.047	0.095	0.155	0.266	0.309	0.400	0.501
Friction against one square foot of surface by Experiments in 1798	0.012	0.043	0.080	0.144	0.209	0.279	0.354	0.432

Now, as several opportunities occurred of observing, that there was a material difference between the resistance of the bodies when drawn through the water, both before and after they were water soaken, and that they always met with more resistance after they were water soaken, there is no reason to doubt but the difference in the friction, as above, arises from the cause here explained.

It is proper to add, that bodies were occasionally drawn through the water, which had been immersed long enough to gather a little slime upon them; and that these bodies were immediately after drawn through the water by means of the same motive power, with the slime washed off, whence it was found that the clean bodies always came the faster.

Upon considering the results of the various experiments that have been made respecting the effect of the friction of the water on moving bodies, it is evident, that the resistance arising from the friction (even against very smooth surfaces) is considerably more than it has generally been conceived to be, or than has hitherto been accounted for, in the estimation of the resistance which bodies meet with in moving through water at different velocities. Whence it naturally follows, that, although ships may be built ever so much alike in their form and dimensions, yet still a very little difference in the smoothness of their bottoms (or in putting on the copper in coppered ships) will produce a considerable difference in their resistances, and of course in the comparative rate of their sailing.

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§ 3. EXPERIMENTS ON THE RESISTANCE OF DIFFERENT BODIES, BY CHARLES GORE, ESQ. OF WEIMAR, IN SAXONY.

The following experiments, made at Greenland Dock, by Charles Gore, Esq. of Weimar, in Saxony, may be considered as a valuable supplement to those made by order of the Society for the Improvement of Naval Architecture, to whom an account of the results was presented by the ingenious author.

These Experiments were made with great precision, by means of the apparatus belonging to the Society at Greenland Dock. They tend, like the former, to shew, that the first principles of Naval Architecture have been hitherto very imperfectly understood; and certainly lead, as the Author has observed, to refute those absurd maxims which have so long governed the constructors of shipping.

The Experiments are too clear, too simple, and their application to practice too obvious, to need any farther illustration than the accompanying figures, and the results which follow.

The bodies *(see Plate E)* were all drawn by one motive weight, viz. one pound and a half, and differed in their velocities as follow:

Figure 1.—Velocity 2.717 feet per second; and weight = 25 lbs. 4 oz.

Figure 2.—Velocity 2.664 feet per second; and weight = 25 lbs. 4 oz. This being the first body reversed. Therefore figure 1. exceeded it in velocity by .053.

Figure 3.—Velocity 2.745 feet per second. This body is similar to figure 1, excepting in the fore part, which is formed with a hollow instead of a round, and which reduces the weight to 23 lbs. 4 oz. being 1 lb. 12 oz. less than fig. 1, and therefore its velocity exceeds that of fig. 1. by .028, which is supposed unequal to the defalcation of capacity and consequent stability. It

is also certain that this form would be more subject to pitching in a sea, by reason of the great inequality of the two ends, whereby the essential counterpoise is destroyed; and, it follows, therefore, that the velocity must be diminished; as it cannot be doubted but that the vessel which preserves its equilibrium in a sea, will pitch less, and must consequently *(cæteris paribus)* be capable of greater general velocity.

FIGURE 4.—Velocity 2.775 feet per second.—Fig. 4. is fig. 3. reversed, consequently its weight equal; and, though it exceeds the velocity of fig. 2. by .111, this increase in velocity seems to be produced rather by the decrease of weight than by the variation of form. Fig. 4, with its full part forward, as represented, gains upon fig. 3, .130 in point of velocity.

FIGURE 5.—Velocity 2.994 feet per second; and, although its weight was 28 lbs. 8 oz. it exceeded fig. 1. by .277.

FIGURE 6.—Velocity 2.888 feet per second; and its form similar to fig. 5, with the addition only of a little fulness forward, which increases its weight to 29 lbs. 4 oz. It loses in velocity only .106, which is supposed to be counterbalanced by the power of additional sail, which this augmentation would enable the ship to carry.

FIGURE 7.—Velocity 2.944 feet per second. This is fig. 6. reversed, by which the velocity increased .056. This body demonstrates, that fulness abaft, to a degree obvious to a critical eye, on inspection of the figure, does not impede the motion through the water.

FIGURE 8.—Velocity 2.837 feet per second. This body has a farther addition or more fulness than figure 6, whereby its weight is increased to 30 lbs. 8 oz. yet loses in velocity only .051 by the last increase, though it still exceeds fig. 1. and fig. 2. considerably, notwithstanding 5 lbs. 4 oz. increase in the weight.

FIGURE 9.—Velocity 2.741 feet per second. This is fig. 8. reversed, by which the velocity is diminished .096. Here the fulness abaft seems to be carried too far.

FIGURE 10.—Velocity 2.871 feet per second, and similar to fig. 9, but carried sharper aft, as may be seen in the figure. The weight 32 lbs. 8 oz. Less by .047 in velocity than fig. 9. This shews that the after part is here also too round. In this figure it will be observed, that the extreme breadth is before the centre. This figure (10) reversed had a velocity of 2.918, which, though it increased in weight 4 lbs. more than fig. 5, brings the velocity equal to figure 5, within .076, notwithstanding the considerable increase in capacity, and consequently in stability. Here it must be observed, that the extreme breadth is abaft the centre as much as fig. 10. is before it.

FIGURE 11.—Velocity 2.669 feet per second. This is similar to fig. 10, but with the same addition forward as abaft, by which it loses in velocity only .202, a loss whose ample compensation will be found in the addition of capacity, and consequent stability to carry sail.

FIGURE 12.—Velocity 2.997 feet per second, and its weight 38 lbs. Similar on the horizontal plane to fig. 11, but curved on the perpendicular plane on the foremost end, and it exceeded fig. 11. in velocity .328, which fully compensates the small defalcation of capacity.

FIGURE 13.—Velocity 2.743 feet per second, and its weight 38 lbs.—This is fig. 12. reversed, with the curved end aft. It loses in velocity, compared with fig. 12, .254. This furnishes an additional argument in favour of placing the sharpness forward.

Figure 14.—Velocity 3.435 feet per second, and its weight 36 lbs. It is similar to fig. 13, but with both ends curved, by which alteration it gains in velocity .692 more than fig. 13.

Figure 15.—Velocity 1.661 feet per second, and its weight 26 lbs. 8 oz.

Figure 16.—Velocity 1.590 feet per second, and its weight 54 lbs. This is likewise a parallelopipedon of the same breadth and depth, but twice the length of fig. 15; notwithstanding which increase in length and weight, the diminution in velocity is only .071. This clearly demonstrates the great advantage derived from length.

Figure 17.—Velocity was 1.806 feet per second, and its weight 50 lbs. 12 oz. This is likewise a parallelopipedon.

Figure 18.—Velocity 1.330 feet per second, and its weight 101 lbs. 8 oz. This is a parallelopidon of the same length and breadth, but twice the depth of fig. 17. It loses, in comparison with fig. 17, .476 in velocity, which proves that the resistance is increased more by the addition of depth than by that of length.

We might conclude, from the foregoing Experiments, that the best form calculated for velocity is a long parallel body terminating at each end in a parabolic cuneas, having the extreme breadth in the centre. Also that making the cuneas more obtuse than is necessary to break with fairness the curve line into the straight, creates a considerable degree of impediment; and we may be inclined to infer, from what has been stated, that the length of ships, which has already been extended with success to four times the breadth, is, *with respect to velocity*, capable of still farther extension to advantage.

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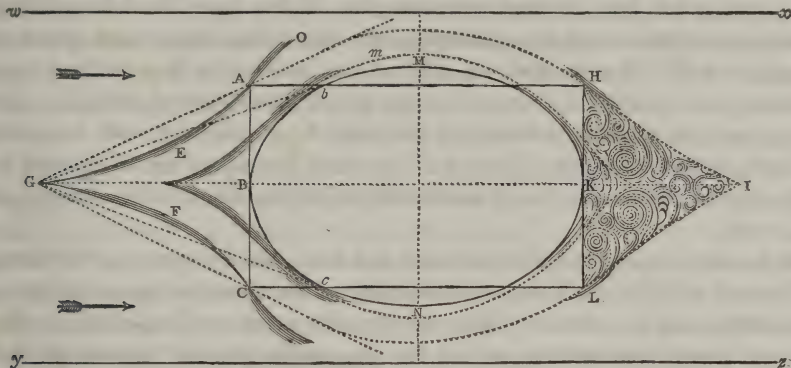
§ 4. OF THE MOTION OF FLUIDS, OPERATING ON FLOATING OR RESISTING BODIES.

We have seen, in the preceding sections, the effects of a great number of bodies of various forms, in their respective degrees of resistance to the pressure or impulsion of fluids. Of the principle or nature of pressure we may form ideas tolerably correct, in general cases, from the hydrostatic principles already explained; but of repulsions we have yet to learn the mode or *manner* of action, whereby some satisfactory ideas may be collected as to the *causes* of the effects which we have seen produced.

Of this subject our knowledge is as yet imperfect. From its nature, Experiments to ascertain its principles appear to be difficult, and, perhaps, at last, unsatisfactory: those which have been made are consequently few, and the conjectures of philosophers very uncertain. As, however, it may be gratifying to the artist to see how much has yet been done in this respect, we shall conclude this chapter with the following observations.

We may, in the first place, conceive a fluid advancing directly against the flat surface of a solid, as the side or end of a cube or parallelopiped; here it is clear, that the body will be struck by a force proportional to the quantity of surface and velocity of the fluid, according to the principles heretofore explained. But the question now is, in what *manner* does the fluid operate, what particles or filaments immediately strike the body, and how are they deflected? The process appears to be nearly as represented in the annexed figure, supposed to represent a solid floating in a stream of fluid, by which it may be observed, that there remains at the anterior part or head end of the body a quantity of fluid, as AGC, operating as if almost stagnant,



and having two curved concave sides AEG, CFG, along which the middle filaments glide. This fluid, which is very slowly changed, would, if there were no cohesion or friction, have a determined ratio to the size of the body, if of similar shape; as there can be no doubt but that the figure AEGFC would in every case be similar. But, with the disturbing force of tenacity in the fluid, a change of form in this otherwise still body must happen. The friction also, which produces an effect proportional to the velocity, must likewise alter the ratio; and we may conclude that the effect of both these circumstances will be to diminish the quantity of this fluid, otherwise stagnant, by licking or involving it away externally; and to this must be ascribed the well known fact, that it is never perfectly stagnant, but generally has a whirling motion. We may also conclude that this fluid at the head of the body will be more incurvated between G and C, than it would have been independent of tenacity and friction; and that the arch HI, astern, will, on the contrary, be less incurvated. And we may conclude, that there will be something opposite to pressure, or what may be called *abstraction* or *minus pressure*, exerted on the stern or hinder part of the body. For the stagnant fluid, or dead water astern, HKI, adheres to the surface HK; and the passing fluid, which flows in the direction of the parallel lines *w x*, *y z*, tends to draw it away both by its tenacity and by its friction. This must, of course, augment the apparent impulse of the stream on such a body, and it must greatly augment the resistance, that is, the motion lost by this body in its progress through the fluid: for the body must drag along with it this stagnating water, and drag it in opposition to the tenacity and friction of the surrounding fluid. The effect of the dead water, ahead and astern, constitutes therefore the greatest part of the resistance of floating bodies.

Hence we find that those bodies which are so formed as to have least of this dead water at head and stern may be considered as the solids of least resistance; and that on such a figure or parallelopiped, whose head and stern ends are square and perpendicular, as in the above figure, the plus and minus pressures (together) will be greatest, increasing proportionably with the breadth of the figure, and decreasing in proportion to the length or change of figure, as will clearly appear by reference to the foregoing experiments.

If we contemplate the operation of a stream of fluid upon another figure, as on an ellipsis or oval, BMKN, we shall perceive that the resistance must be less, because the quantity of dead water will be less both at head and stern; for, in this case, the deflected filaments form angles much more obtuse with the direction of the stream than they would, if deflected by the square surface ABC; likewise that the stern pressure will be less disturbed and be more equal in comparison with the other pressures than that of the parallelopiped AHCL. It is obvious, for instance, that the filament deflected by the point A, of the latter, will be deflected in the direction AO, while the filament deflected by the outer point b, of the ellipsis, will be deflected in the direction bm, which more easily unites with the stream, and with the pressure on the after part of the body.

If there be some distance between the head and stern, the divergency of the filaments which had been turned aside by the head, is diminished by the time that they come abreast of the stern, and should turn in behind it. They are therefore more readily made to converge behind the body, and a more considerable part of the surrounding pressure remains unexpended, and therefore presses the water against the stern; and, it is evident, that this advantage must be so much the greater as the body is longer, not however exceeding a certain length.

This subject might be extended hence to a considerable length *, but it is presumed that the above examples will be, to the intelligent reader, a sufficient guidance to the application of the true theoretic principles in all other cases; especially where aided by the Experiments which have been described. We shall, however, describe some particulars of the beautiful experiments made by the late celebrated Admiral Sir Charles Knowles, for ascertaining the paths of the filaments of water in cases of impulsion; and some other experiments, equally ingenious and important, made by the Chevalier Buat, and which corroborate the truth of the English experiments.

1. EXPERIMENTS MADE BY SIR CHARLES KNOWLES.

At a distance up a stream the Admiral allowed small jets of a coloured fluid, which did not mix with water, to make part of the stream; and the experiments were made in troughs with sides and bottom of plate glass. A small taper was placed at a considerable height above, by which the shadows of the coloured filaments were most distinctly projected on a white plane held below the trough, so that they were accurately drawn with a pencil.

The still water AGC *(see the foregoing figure)* lasted for a long time before it was renewed; and it seemed to be gradually wasted by abrasion, by the adhesion of the surrounding

* To those who wish to pursue this subject, with mathematical nicety, we recommend a perusal of the Article *Resistance*, in the Encyclopædia Britannica.

water, which gradually licked away the outer parts from G to A and C; and it seemed to renew itself in the direction BG, opposite to the motion of the stream. There was, however, a considerable intricacy and eddy in this motion. Some (seemingly superficial) water was continually, but slowly, flowing outward from the line GB, while other water was seen within and below it, coming inwards and going backwards.

The coloured lateral filaments were most constant in their form, while the body was the same, although the velocity was in some cases quadrupled. Any change which this produced seemed confined to the superficial filaments.

As the filaments were deflected, they were also constipated or thickened; that is, the curved parts of the filaments were nearer each other than the parallel straight filaments up the stream; and this constipation was more considerable, as the head end was more obtuse and the deflexion greater.

When the body exposed to the stream was a box of upright sides, flat bottom, and angular prow, like a wedge, having its edge also upright, the filaments were not all deflected laterally, as theory would make us expect, but the filaments near the bottom were also deflected downwards as well as laterally, and glided along at some distance under the bottom, forming lines of double curvature.

The breadth of the stream that was deflected was much greater than that of the body; and the sensible deflection began at a considerable distance up the stream, especially in the outer filaments.

Lastly, the form of the curves was greatly influenced by the proportion between the width of the trough and that of the body. The curvature was always less when the trough was very wide in proportion to the body.

Great varieties were also observed in the motion or velocity of the filaments. In general the filaments increased in velocity outwards from the body to a certain small distance, which was nearly the same in all cases, and then diminished all the way outward. This was observed by inequalities in the colour of the filaments, by which one could be observed to outstrip another. The retardation of those next the body seemed to proceed from friction, and it was imagined that without this the velocity there would always have been greatest.

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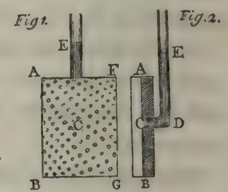
2. EXPERIMENTS ILLUSTRATIVE OF THE MOTIONS OF RESISTED FLUIDS, BY THE CHEVALIER DE BUAT.

It appears, from some experiments made by a very ingenious French writer, the Chevalier de Buat, that the resistances of different surfaces, *equally immersed*, is greater than in the proportion of the breadth. That is to say, a broader plane, when it is not completely immersed, will be resisted more than a narrower one, equally immersed, by a resistance greater in proportion than the difference of breadth. For example: we will suppose two planes, A and B, of which the lesser (A) shall be one foot square, and the larger (B) two feet broad by one foot deep. Let these be equally immersed: then will the resistance of B be greater in proportion to its surface than the resistance of A in proportion to its surface. For, it is evident, that there will be an accumulation against both; but the elevation against B will be proportionally greater than that against A, because the lateral escape of the water from the greater surface is more difficult than that from the lesser, as will appear from the following experiments.

The instrument made use of in these experiments was that represented in the margin. It consisted of a square brass plate, ABGF, pierced with a great number of holes, and fixed in front of a shallow box, represented edgewise in fig. 2. The back of this box was pierced with a hole C, in which was inserted the tube of glass CDE, bent square at D. This instrument was exposed to a stream of water, which beat on the brass plate. The water having filled the box through the holes, stood at an equal height in the glass tube, when the surrounding fluid was stagnant; but, when it was in motion, it always stood in the tube above the level of the smooth water without, and thus indicated the pressure occasioned by the action of the stream.



When the instrument was not wholly immersed, there was always a considerable accumulation against the front of the box, and a depression behind it. The water before it was not stagnant; indeed it could not be; for, as M. Buat observes, it consists of the water which was escaping on all sides; and, therefore, upwards from the middle of the stream, which meets the plate perpendicularly in C, considerably under the surface. It escapes upwards, and, if the body were sufficiently immersed, it would escape in this direction almost as easily as laterally. But, in the present circumstances, it heaps up, till the elevation occasions it to fall off sideways as fast as it is renewed. When the instrument was immersed more than its semi-diameter under the surface, the water still rose above the level, and there was a great depression immediately behind this elevation. In consequence of this difficulty of escaping upwards, the water flows off laterally; and, if the horizontal dimensions of the surface be great, this lateral efflux becomes more difficult, and requires a greater accumulation. From this it happens, that the resistance of broad surfaces, equally immersed, is greater than in the proportion of the breadth.

It was therefore found that the pressure on the centre was much greater than towards the border; and, in general, the height of the water in the tube DE was more than four thirds, or one and one third of the height necessary for producing the velocity when only the central hole was open. When various holes were opened at different distances from the centre, the height of the water in DE continually diminished as the hole was nearer the border. At a certain distance from the border the water at E was level with the surrounding water, so that no pressure was exerted on that hole. But the most unexpected and remarkable circumstance was, that in great velocities, the holes at the very border, and even to a small distance from it, not only *sustained no pressure, but even gave out water;* for the water in the tube was *lower* than the surrounding water. M. Buat calls this a non-pressure. In a case in which the velocity of the stream was three feet, and the pressure on the central hole caused the water in the vertical tube to stand thirty-three lines, or thirty-three twelfths of an inch, above the level of the surrounding smooth water, the action on a hole at the lower corner of the square caused it to stand twelve lines lower than the surrounding water. The intermediate holes gave every variation of pressure, and the diminution was more rapid as the holes were nearer the edge; but the law of diminution could not be observed.

This was a new and unexpected circumstance in the action of fluids; yet it will be found consistent with the genuine principles of hydraulics: for a consideration of the subject will shew, that if the middle alone were struck with a considerable velocity, the water might even rebound, as is frequently observed. This actual rebounding is here prevented by the surrounding water, which is moving with the same velocity: but the pressure may be almost annihilated by the tendency to rebound of the inner filaments.

Part, (and perhaps a considerable part) of this apparent non-pressure is certainly produced by the tenacity of the water, which licks off with it the water lying in the hole. At any rate, this is an important fact, and gives great value to M. Buat's experiments.

From the experiments it appeared also that, with respect to the resistance, it is of no less consequence to attend to the form of the hinder part of the ship than to the shape forward. This truth seems to have been established by the experience of all nations. Nevertheless M. Buat particularly directed his experiments to the ascertainment of this object, and with success; for they plainly shew the great importance of due consideration as to the action of the fluid on the after part of the body.

It is clear, from what has been before advanced, that the whole impulse or resistance, which must be withstood or overcome by the external force, is the sum of the active pressure on the fore part, of the non-pressure on the hinder part, and the effect of adhesion; or, in other words, the sum of the plus and minus pressures and of friction. The experiments of M. Buat shewed that this does not depend solely on the form of the head, but also on the length of the body. It appeared by some of the experiments, that the non-pressure on the hinder part was prodigiously diminished (reduced to one fourth) by making the length of the body triple of the breadth. And hence it appears, that merely lengthening a ship, without making any change in the form either of her head end or stern end, will greatly diminish the resistance to her motion through the water; and this increase of length may be made by continuing the form of the midship frame in several timbers along the keel, by which the capacity of the ship, and her power of carrying sail, will be greatly increased, and her other qualities improved, while her speed is augmented.

§ 5. GENERAL OBSERVATIONS ON VESSELS CALCULATED TO SAIL WITH GREAT VELOCITY; INCLUDING A DESCRIPTION OF THE FLYING PROA OF THE LADRONE ISLANDS.

WE have already shewn, from the hydrostatic principles and the experiments described in the foregoing sections, the figures which are least exposed to the effects arising, simply, from the resistance and adhesion of the water; and, from these, we presume, it will be sufficiently apparent how the heads and sterns of vessels may be formed so as to have the greatest advantage with respect to velocity: or, rather, what forms are best calculated for passing through the water with the greatest celerity.

From what has been there premised, and, indeed, from universal experience, it will be evident, that vessels having but a small draught of water in proportion to their other dimensions, will pass before the wind with the greatest celerity; because the resistance of the fluid increases more in proportion to the depth immersed than to an increase breadthwise in the opposing surface. Hence, a vessel having a keel thirty feet in length, and drawing five feet water, will have much less resistance, in proportion, than one drawing ten feet water, and being sixty feet in length; because the lateral resistance increases, nearly, in proportion to the square of the side, or surface, presented to the water.

In this case, it is evident, that the desirable quality of holding a wind will be proportionally less as the vessel is more shallow, and that such vessels will be more leewardly in proportion as they have less hold of the water.

An increase of length may be proposed as a remedy, in some measure, for this disadvantage, and some other methods, as we shall shew hereafter; as well as that a vessel may be built with a very narrow breadth of floor, and in every respect what is termed sharp, so as to sink considerably lower beneath the line of floatation than if built more flat; thus it may continue to present the same face or quantity of surface to the fluid as a lateral resistance, and consequently be as little liable to fall to leeward. But its disadvantages will now be, that it will experience much more resistance, in the first instance, in its passage through the water; its very contracted capacity in proportion to its measurement, and the expense of construction; its great draught of water and incapability of sailing where vessels built more flat would be capable of passing; with the extreme danger to which it would be exposed in case of touching the ground, even in that slight degree which would give no reason for apprehension in a flat floored vessel.

Of all the vessels in the world, calculated to move through water with great facility, and at the same time hold a good wind, the Flying Proa of the Ladrone Islands is, perhaps, the most striking example. A description of that vessel may not, therefore, be uninteresting to the reader. We give it here, not only as an object of great curiosity in itself, but because some useful elementary principles and ideas may be deduced from the invention. We shall therefore consider it in the light of an experimented body, worthy of particular consideration, and describe it, nearly, in the words of the learned and ingenious Mr. Charnock, in his History of Marine Architecture.

This very extraordinary boat or canoe, of which the plan is given on the plate marked F, is the most celebrated of the numerous vessels constructed by the unlettered natives of the southern hemisphere; and is supposed to have been in use for several centuries ere they became known to Europeans. Some of our navigators, who have seen it, beheld its operations and principles with an admiration bordering almost upon enthusiasm; and have described it as an invention that would do the highest honour to any country whatever, let its nautical aptitude, skill, and dexterity, be whatever they might.

The Islands, of which the Flying Proa may, without any impropriety, be termed the native, lie all of them nearly under the same meridian; a meridian under which the trade winds constantly prevail. This circumstance would, of necessity, render any voyage extremely tedious, if attempted by a vessel constructed according to the common, or European form; for, the wind, during the whole of the voyage, being constantly on the beam, would inevitably drive the vessel so far to leeward, as to render it impossible for it to reach its point of destination, except by making long and tedious traverses.

When we examine the uncommon simplicity and ingenuity of its fabric, its contrivance, and the extraordinary velocity with which it passes through the water, we shall find it equally worthy of admiration in all these points.

The name of the *Flying Proa* has been given to this vessel on account of the extraordinary, and, in some measure, incredible velocity with which it is said, by various observers, on the positive evidence of their own sight, to pass through the water. "The Spaniards," according to the ingenious author of Commodore Anson's voyage, "assert such things of it as must appear altogether incredible to one who has never seen these vessels move;" nor are they the only people who recount such extraordinary tales of their celerity, for those who shall have the curiosity to enquire at Portsmouth Dock Yard, about an experiment tried there several years since, with a very imperfect proa, built at that place, will meet with accounts no less wonderful than those which have been reported by the Spaniards. "Nevertheless," continues the author, "by some rude estimations made by us, of the velocity with which they crossed the horizon at a distance, while we lay at Tinian, I cannot help believing, that, with a brisk trade wind, they will run nearly twenty miles in the hour, which, though greatly short of what the Spaniards report, is certainly a degree of velocity that, without the most positive evidence, might be considered incredible."

The construction of a Proa is directly opposite to every principle of marine architecture, which, in other quarters of the Globe, had been before embraced by the most polished and scientific nations. It is well known to be a prevalent custom, that the head and stern of a vessel should bear no resemblance to each other, but that the two sides should be exactly alike. In the Proa, however, no difference is discernible between the head and stern, but the formation of the sides is as dissimilar as it is possible to conceive they could be. The cause of this very extraordinary formation is easily to be discovered. The Proa never puts about, but is intended, and actually sails with either end foremost, according to the pleasure of the navigators; one and the same side being constantly exposed to the wind. This is, according to the custom of other countries, built rounding, and not very materially varying from the form given by Europeans themselves. The lee side, however, is totally flat, and, owing to the extreme length of the vessel, with its want of breadth, would immediately overset, but for a contrivance and addition, as curious as it is useful, which prevent an accident of this disastrous kind. A frame or out-rigger is fixed on the rounding or weather side, extending some distance over the water; and at its extremity is fastened a log of wood, fashioned, in some degree, into the form of a boat, which prevents its falling over to leeward under a pressure of sail, and preserves it from all risk of oversetting, as it certainly would do, without such addition, from its very contracted breadth.

The hull of the Proa itself, properly so called, *(See Fig. 3. Plate F.)* is formed of two pieces of wood, joined edgeways, and sewed together, according to the custom of the country;

no iron whatever being used in the construction. The bottom, that is to say, the part of it next the keel, to use the term adopted in European vessels, is about two inches in thickness, and gradually diminishes as it approaches the gunwale, where it becomes reduced one half, or is, perhaps, even less than an inch in thickness. The singularity and extraordinary properties of this vessel cannot fail to render its representation more than commonly interesting; and the dimensions, as well as form, of each part, will be far more accurately understood by inspection of the plate than by the most laboured description; the former of which becomes additionally curious, as being taken from an actual measurement of the different parts. Figure 1. is a sheer draught of the Proa, with her sail set, as seen from the leeward; fig. 2. exhibits the projection or form of the hull, as viewed from the head, with the outrigger to windward; fig. 3. is the horizontal plan of the vessel; AB representing the lee side; CD the windward or weather side; EFGH the outrigger or balancing frame; KL the boat or block of wood attached to it; MN and PQ two braces, springing from the head and stern, in order to steady and strengthen the outrigger; RS is a thin plank, fixed to windward, in order to prevent the Proa from shipping water; it serves also as a seat for the person who is constantly employed in baling the vessel, in order to keep it clear from the water which it is constantly shipping. This contrivance serves likewise, occasionally, to carry such merchandize, or commodities, as the insignificance of the vessel will permit. I is the centre part of the frame, or outrigger, in which the mast is fixed. The latter is sustained and strengthened, as seen in figure 2. by the shore CD and the shroud, as well as by the shroud EF, together with two stays, one of which is visible in fig. 1. marked CD; the other is hidden by the intervention of the sail. The sail, whose form is accurately shewn in fig. 1. is made of matting. The mast, yard, boom, and outrigger, all of bamboo. The heel of the yard is always laid on one of the sockets marked V. and T. fig. 3. according to the tack on which the Proa stands, and when the navigators wish to alter it, it is effected in the following simple and artless manner: they bear away a little to bring the stern up in the wind, when, by trivially easing the haliard, raising the yard, and carrying the heel of it along the lee side of the Proa, they fix it in the opposite socket. The boom at the same time, by letting fly the sheet M, and hauling that marked N, represented in fig. 1. is shifted into the contrary situation to that in which it before stood; so that what had appeared as the stern of the Proa, immediately becomes the head, and the Proa is trimmed on the contrary tack. When it is considered necessary either to reef or furl the sail, it is effected by rolling it round the boom.

These vessels or proas in general carry six or seven men, two of whom are stationed in the head or stern, and steer it alternately with a paddle, according to the tack on which it is; the person in the stern being, as might be naturally supposed, the steersman. The remainder of the crew are employed, either in occasionally baling out the water which is casually shipped, or trimming the sail. It must be sufficiently obvious, from the description of this vessel, how peculiarly it is adapted to the navigation of that cluster of islands known by the names of Ladrones. These bearing N. and S. of each other, and being all within the limits of the trade wind, the Proas, whose peculiar excellence consists in their sailing nearer to the wind than any vessels in the known world, are enabled to perform their contracted voyages, and pass from one island to another, as well as back again, by only shifting the sail, as either end will answer for the head. The advantages they derive from the flatness of their lee side, and their very narrow breadth in proportion to their length, materially co-operate in preventing them from making lee-way ; and such is their swiftness, that some persons have imagined they actually pass through the fluid with greater velocity than the wind itself does over it. This experiment, however, owing to the want of a proper apparatus, has never perhaps been sufficiently tried to warrant a determination as to its truth : notwithstanding the ingenious author of Commodore Anson's voyage has had recourse to all the subtlety of argument in the hope of establishing the fact.

" Thus much," continues the author, " may suffice as to the description and nature of these singular vessels; but it must be added, that vessels bearing some obscure resemblance to them are to be met with in various parts of the East Indies; but none of them appear comparable with those of the Ladrones, either in respect to construction or celerity : a circumstance which may, in some measure, induce mankind to believe, that the Proa is the real native and original invention of the inhabitants of these Islands, and was afterwards imperfectly copied by the inhabitants of neighbouring countries. For, though the Ladrones have no immediate intercourse with any other people, yet a considerable number of Islands lie to the South and South West, which are imagined to extend nearly to the coast of New Guinea.

In the very singular piece of nautical mechanism just described, may, in great measure, be discovered the principle of that well known invention, the European lee-board, though produced by a contrivance not only dissimilar, but almost totally different. The effects, however, are almost completely the same. The weight of the out-rigger, or second boat, proves so sufficient a stay or balance to the principal, as to prevent it from ever oversetting : while the increased lateral resistance which the clear run of the lee side makes to the water, prevents the canoe from making that lee-way, the inconvenience of which it would otherwise have to encounter, in consequence of the wind being constantly on the beam.

The vessels of the Dutch, and several other northern nations, particularly those intended for commercial purposes, are so constructed as to be singularly buoyant or floatsome; consequently as subject to fall to leeward, and liable to other inconveniences, when the wind is not considerably abaft the beam. Hence the mariners of those nations adopted, in remedy of the inconvenience, the invention of the lee board; for, this instrument of stability, being drawn up or let down into the water, at pleasure, according to the tack on which the vessel may happen to be (one being fitted to each side,) will, from its hold on the water occasioned by its reaching, when brought into use, considerably lower than the bottom of the vessel, make that resistance to the impulse of a lateral or side wind, which not only serves to keep the vessel upright, but also enables it to make head way with infinitely less deflection, from its intended course, than would inevitably take place, were such addition wanting.

Thus, we see that these inventions, so opposite in their principles, and so totally dissimilar in every point of action and mechanism from each other, productive of the same specific advantage; and we shall hereafter see that there are superior methods of preventing vessels of small draught of water from falling to leeward, which have, apparently, grown out of these and other simple inventions.

In contemplating the contrivances of the Ladrone Islander, the scientific European may, perhaps, confess, that the most elaborately given form, regulated by long study and the strictest philosophical attention, could not have proved more productive of success. The breadth of the sail below enables it to hold a larger portion of wind than it would be safe to encounter, did it bear any other form than that which it precisely does; and, were the canoe even destitute of the out-rigger, the contraction of it aloft proves no small preventative from accident; while the simplicity promises the most expeditious mode of reducing it, and totally obviating any of those misfortunes to which vessels rigged in a more complex manner are not unfrequently liable. In short, artless ingenuity pervades the whole, and the natural force of the human mind rises, in this instance, splendidly triumphant over scholastic science and philosophy *.

In the succeeding Chapter we shall endeavour to elucidate more fully the principles demonstrated or advanced in the foregoing; and to shew their more immediate application in the construction of shipping.

* See Charnock's History of Marine Architecture, Quarto, Vol. 3.

CHAPTER III.

ON THE FIGURE AND CONSTRUCTION OF SHIPS AND VESSELS IN GENERAL, AND ON THE MEANS OF GIVING THEM THE MOST DESIRABLE QUALITIES:

WITH REMARKS ON THE DIFFERENT CLASSES OF BRITISH SHIPPING.

§ 1. GENERAL OBSERVATIONS.

WE have seen, in the preceding chapter, the result of a considerable number of experiments, leading to the fundamental knowledge of those principles that govern the passage of floating bodies, variously shaped, through the water; and from which we may deduce, generally, the degree of resistance that a body, of any particular form, is likely to meet with from the fluid. We are, therefore, furnished with the means of estimating, in general cases, the forms of ships which are best adapted for sailing with the greatest celerity, so far as they depend upon the figure of the immersed body.

As, however, a ship is not merely a vessel of passage, but also a vessel of burthen, and required, generally, to possess a certain determinate capacity, it becomes requisite to enquire into the means of giving, collectively, all other desirable qualities, as well as that which is particularly calculated for velocity: this enquiry shall, therefore, be the subject of our present chapter; the object of which is, to investigate the principal points of consideration in a ship's body, so as to give it such a shape as may best answer the particular purposes for which the ship is designed.

The subject is attended with some difficulty; because the properties which every ship ought to possess are, in a manner, subversive of, or in opposition to, each other. One figure is required for extraordinary swiftness, another for extraordinary strength or capacity; and all are regulated, more or less, by peculiar and local circumstances. The great art, however, in all places and under all circumstances, consists, in so forming the body, that none of the desired qualities shall be entirely wanting; giving, at the same time, the advantage or preference to that which is most required in the principal designation of the vessel.

In no case, whatever, is consideration, combination, and strength, more necessary than in the formation and construction of ships; particularly ships of war, wherein strength, celerity, and convenience, are prime requisites: and, holding in contemplation the construction of such a body, our first object must be, to consider the various purposes that it is intended for, and the various impediments that it may meet with in the prosecution of those purposes, in order to the arrangement of its parts and combination of its principles; especially where it be necessary that contradictory powers shall be blended together, and wherein one principle shall not predominate too much over another.

To guide our judgment aright, as to the degree of perfection which ship-building may have already attained, let us divide the vessels of all nations into two classes: the first containing the smallest vessels, used chiefly in the coasting trade and for short voyages; the second comprising the largest vessels, adapted for long voyages and the navigating of extensive oceans.

In examination of the first class, we find vessels which different nations make use of, either for their home trade, or to transport the produce of their country to the neighbouring nations. But, as the nature of climates, the extent and depth of seas, the position of countries with respect to those seas, and even to each other, as well as their several productions, are materially different between nation and nation, so their vessels could not all be of the same species; but must necessarily be controuled, both in form and rigging, by those circumstances. Hence, therefore, exists, in this very variety, a degree of perfection which adapts them to their several destinations.

To the circumstances above mentioned are attributable the flat floored vessels of the Dutch and other northern nations: to the same causes may be ascribed the round or arched stern generally adopted by those nations. The former, because the shallow depth of water on their coasts would prevent or impede the ready admission of vessels otherwise constructed into their ports; and the latter, because that circular form which is given to the stern, is supposed to render vessels more capable of resisting the assaults of the waves, occasion them to be more floatsome, and prevent their being buried in the hollow of a cross sea, or pooped, as might be the case if constructed upon different principles.

To the local circumstances of other climates are, in like manner, to be attributed the sharp figure of those vessels peculiarly adapted for velocity, &c. as the Proas, the Periaguas, and canoes of various descriptions, made use of by the natives of the southern hemisphere; of which the most striking example is seen in the Flying Proa heretofore described: a vessel which stands as a signal instance how far rude and untutored ingenuity is capable of surmounting those difficulties that might otherwise have been considered as insuperable, except by the most laborious study and profound mathematical knowledge. These vessels, although, generally, much smaller, form a direct and striking contrast to the former; but each are best adapted and fitted for those seas and countries to which they respectively belong.

To the intermediate regions belong those vessels that combine, in great measure, the properties of each of the former; and here we see vessels, having the figures both of stem and stern modified accordingly. Neither the sharp stem, nor the more bluff or prominent bow, are in Britain carried to excess; and the advantages of both are here, in great measure, united.

If, now, we turn our consideration to vessels of the second class, namely, those adapted for long voyages, &c. we shall observe that, being built for one and the same end, they have a greater similitude in their principal parts, although built by different nations. Looking to their *principal dimensions*, we shall find, that their extreme breadth is between a third or a fourth of their length; that the smaller of these vessels have greater breadth, with respect to their length, than the larger vessels; that their draught of water is somewhat more or less than half their breadth; and that the height above the load-water line has also its general limits, according to the destined employment of the vessel. As to what regards the internal fittings-up, vessels of all nations are nearly alike, differing only in things not essential, in which every person consults his own convenience. Considering their forms, we find them, generally, to have their extreme breadth a little before the midship frame; that they are narrower abaft than forward; that vessels of heavy burthen have fuller bottoms; while vessels intended for expedition have leaner bottoms, and their stem and stern post have a greater rake; that most vessels draw more water abaft than forward; &c. With regard to their Rigging, most of them have three masts, others two, and some only one, depending chiefly on their size. These masts have, nearly, with respect to the vessel and the manner of rigging, the same dimensions, and are placed in the same manner: they are also generally rigged in the same fashion, except that they carry more or less sail, according to the ideas of the rigger. All vessels have their centre of gravity a little before the midships; and the centre of gravity of the sails is generally before that of the vessel.

After this general mode have been built all the vessels of European nations intended to navigate the high seas; and, as this has been the result of repeated essays, long experience, and numerous changes wrought in consequence, we cannot think of passing, very materially, these general boundaries.

The first and principal point, in forming a ship, whether intended for war or commerce, is, that it shall be a good sea-boat; or, in other words, that it shall be able to endure, with the least possible injury, the shock of the contending elements, winds and waves.

The next object will be, to give the vessel that quality which, consistently with her destined purposes, will give her swiftness or velocity. Here arises an obstacle to perfection in the former case: the vessel of greatest draught being best calculated to make her way against adverse winds; for, having the greatest hold of the water, she is, of course, the least liable to fall to leeward; while another, of less draught, is proportionally more buoyant, and so much the better fitted for services in which particular expedition is required.

The perfection of every ship, whether intended for war or commerce, may be comprehended in four words; STRENGTH, CAPACITY, STABILITY, and SWIFTNESS; as the primary quality of safety, and the secondary qualities of steering well, working well, rolling and pitching easily, are naturally comprised therein.

The STRENGTH of a ship may be said to be in its perfection, when sufficient solidity is given to those parts that are subject to receive sudden and violent action, from the impulse of any force acting upon them; and. when sufficient strength is equally diffused throughout the whole, so that every weight shall have adequate support, and be equal to the resistance of any strain, or the operation of any irregular motion.

The best methods of imparting a due degree of strength to every part of a ship, will be amply considered hereafter, when treating upon the actual construction.

With respect to STIFFNESS OR STABILITY, it may here be observed that, in the construction of a ship of war, the first point to be attended to is, that she shall be so formed as to carry her lower tier of guns at a sufficient height from the water, in all weathers; otherwise they may be rendered useless. For a three-decked ship that cannot open her lower tier of ports upon a wind, but in smooth water only, may be taken by a seventy-four-gun ship, properly constructed, so as to keep her lower-deck ports open. The same may be said of a seventy-four-gun ship, not having sufficient stability; for she may be as easily taken by a thirty-eight-gun frigate, that can make use of all her guns; because, it is evident, that the frigate will then be the most formidable.

Hence we see, that the first thing to be considered in the construction of a ship of war is, to determine on the height of the gun-deck ports above the water at the lowest place, which is commonly at ⊕, or the midships. This we find, in line of battle ships, should invariably be from five to six feet; in frigates, from six to seven feet; and in sloops, cutters, &c. from four to five feet*.

And, hence, we have the height of the Line of Floatation, or Load-Water Line, at the midships, or where the ports are lowest. Then, by determining whether the vessel should float on an even keel, or draw more water abaft than forward, we determine on the line of floatation, or load-water line, of a ship of war, with respect to the ports.

Merchant ships are generally constructed to carry a certain cargo, and their principal dimensions are determined according to the trade for which they are particularly designed; therefore the line of floatation, or load-water line, is not in them so exactly confined to a certain height.

We have already observed, that the qualities required in a ship ought to determine the figure of her bottom: that a ship of war, therefore, should be able to sail swiftly, and carry her lower tier of guns sufficiently out of the water. A merchant ship ought not only to contain a large cargo, but ought also to be fitted so as to be navigated with few hands; and both should have sufficient stability to enable them to carry a press of sail: they should steer well; drive little to leeward; and sustain the shocks of the sea without being violently strained.

The first thing to be established in the draught of a ship is her length; and, as a ship of war, according to her rate, is furnished with a certain number of guns, which are placed in battery on her decks, it is necessary that a sufficient distance should be left between their ports to work the guns with facility, and particularly to leave space enough between the foremost gun and the stem, and between the aftmost gun and the stern-post, on each side, on account of the arching or inward curve of the ship towards her extremities.

When the length of a ship is determined, it is usual to fix the breadth by the dimensions of the midship beam; which are generally regulated according to the experience of the builder, and the particular services for which the ship is designed. Hence have arisen that variety of standards, or general rules, adopted by different artists, who have been accordingly divided in

* See folio I. of the Tables of Dimensions and Scantlings hereafter.

their opinions with respect to the breadth which ought to be assigned to a ship, relatively with her length. Those who would diminish the breadth have alledged, and truly, that a narrow vessel meets with less resistance in passing through the water; 2dly, that by increasing the length she will drive less to leeward; 3dly, that, according to this principle, the water lines will be more conveniently formed to divide the fluid; 4thly, that a long and narrow ship will require less sail to advance swiftly; that her masts will be lower and her rigging lighter; and, by consequence, the seamen less fatigued with managing the sails, &c.

The reasons given, on the contrary, for enlarging the breadth, appear equally cogent. These are, 1st, that this form is better fitted to preserve a good battery of guns; 2dly, that there will be more room to work the guns conveniently; 3dly, that by carrying more sail the ship will be enabled to run faster; or, that this quality will at least overbalance the advantage which the others have of more easily dividing the fluid: 4thly, that, being broader at the load-water line, or line of floatation, they will admit of being very narrow on the floor, particularly towards the extremities; and, 5thly, that a broad vessel will more readily rise upon the waves than a narrow one, &c.

All these particulars, however true in themselves, individually considered, are accompanied with their peculiar disadvantages. As, for instance, with reference to the first case, it will be evident, that, if the bow of a ship be narrow, it must unavoidably pitch deeper than one which is broader, even with a small degree of impulsion*. This can be remedied only by having its forebody so formed, that its bearings shall catch the vessel in its descent; or, in other words, by an increase of breadth or expansion upwards.

It will be necessary, at the same time, that the remaining part of the hull shall be so proportioned, that its effects may not counteract the advantages arising from the figure of the forebody: for, if the after part be not, in like manner, supported by proper bearings, it will dip into the hollow of the sea, and be so much the more liable to the danger of being pooped than if the bow were narrower†. A vessel so constructed, and possessing length or other requisites conducing to make her weatherly, may, if close hauled upon a wind, drive along with more than usual velocity, without dipping or sinking at every wave she meets with; but the great inconvenience will be, the danger that would inevitably exist both with respect to the masts and to the vessel.

On the form of the stern depends the prompt obedience of the vessel to the helm: a proper medium must, nevertheless, be observed. If too fine and taper, the disadvantages that we have just noticed will arise; on the contrary, if too full, the vessel will not be under proper command; for the vacuum (if it may be so called) created by the passage of the hull through the water, will, in this case, extend farther than the width of the rudder; and, consequently, deprive it of its best force. But, although it is extremely requisite that all fullness in the after-

* The movements of pitching are the most dangerous of any to which a ship is subject; as they are those which most fatigue a ship and her masts. It is mostly in one of these motions that masts are seen to break, particularly when the head rises after having pitched.

† To be *pooped*, signifies, to decline so much abaft as to dip the upper part of the stern in the sea; or so much as to permit the sea to break heavily over the stern.

body should be carefully avoided below the line of floatation, yet immediately above it the quarter should spread out, in order to present a sufficient quantity of support when the ship rises forward to a sea; and, in order to 'scend without danger of having her stern driven in by the force of waves that may strike her in that direction.

The stability, or stiffness, of a ship, is that quality by which, when she receives an impulse or pressure in a horizontal direction, so as to be inclined in a small degree, the vessel will regain its former position as the pressure is taken off. This quality, and the want of it, namely, the propensity of a ship to roll, depends chiefly on the figure of the midship bend.

That the nearer the midship body approaches to a cylindrical shape, the more will the ship be subject to roll, is a truth which needs no demonstration. It will be equally liable to upset if the body be too sharp, as we shall hereafter shew; besides the inconveniences of increased draught of water and smaller stowage. A vessel having a flat bottom, and perpendicular sides below the line of floatation, has the greatest stiffness; but such a vessel would, by not being sufficiently lively to yield to the sea when it runs high, be liable to have it frequently beating over her as it would over a rock. A medium, therefore, must be obtained, which shall obviate these disadvantages respectively.

The propensity to rolling, derived from the form of the midship body, may, in some degree, be obviated or reduced, particularly in a vessel of large capacity, by the length or peculiar qualities of the fore and after bodies; but the question is, whether the remedy would not be productive of much greater inconveniences. The most eligible and perfect points of construction will be considered hereafter more largely; but it may be noticed here, that, according to the opinion of the best judges, in the midship frame generally, the floor should be flat, the upper futtock straight, and the extreme breadth elevated above the line of floatation.

The property of stability, as before observed, may, certainly, be considered as the first quality to be attended to in the formation and construction of a ship; inasmuch as, if that be wanting to a certain degree, it will be incapable of putting to sea with any degree of safety. Hence, therefore, the stability of a ship, whether for war or commerce, is the first property to be attended to; since, for want of it, a ship will incline too much, or lie over in the water; and, in case of action, this defect may render, in war, the lower tier of guns entirely useless.

With regard to the sailing trim of a vessel; it is the decided opinion of the most scientific men, that ships or vessels of the larger classes should always be so constructed as to sail with, or nearly with, an even keel. When constructed so as not to sail on an even keel, they draw more water abaft than forward, that being found most advantageous both to their sailing and steerage*. Smaller vessels, in general, draw more water abaft than forward: some, as

* "That vessels will sail best on an even keel, there can, I imagine, be no reason to doubt; but the way, in my conception, to make them sail on an even keel, is, to contrive them so, as that they shall draw more water abaft than before. For the effort of the wind on the sails and masts in forcing the vessel forward must have a constant tendency to depress the fore part of the vessel or keel, and, of course, to make a level keel incline to the bow, and a keel inclining to the stern level."—*Gordon on Naval Architecture,* 1784.

It may, however, be observed, that the accumulation of the water at the bow, will, in proportion to the *plus pressure,* counteract this effect.—*Editor.*

Packets, &c. built for dispatch, considerably more so; as may be seen by a reference to folio I. of the Table of Dimensions and Scantlings hereafter. Cutters have been, commonly, so constructed, although the new one, of which we present a draught *(plate 19.)*, is intended to sail on an even keel. The utility of a vessel's sailing on an even keel is considerable; as, by preserving a proper equilibrium, it preserves the trim of stowage, &c. Of such vessels it is to be particularly observed, that the breadth should be carried well forward; that the body shall diminish gradually abaft from midships; and, that the water lines forward shall not be inflected or hollow; as such are, by no means, adapted for velocity.

If built to draw more water abaft than forward, the main breadth must be raised abaft; which, consequently, will make the after body the cleaner, and so permit it to decline deeper into the water.

The reasons given for constructing vessels of the smaller classes, so as to draw more water abaft than forward, seem, however, relatively to *sailing*, to have been justified by experience. These are, that the bow of a vessel of this description, which meets the fluid in a more slanting instead of a more perpendicular direction, experiences by far the less resistance. The stem of a barge, being of the description here mentioned, causes it, as it were, to slide through the water, and increases the facility of the passage considerably more than if its form were more like that of a sloop. So, in this case, the resistance against the bow itself is comparatively trivial; for if, like the barge, it be made to slide, as it were, along the water, it will suffer the greater part of the keel to pass through the fluid almost without opposition. The stern, if very fine or taper, necessarily contributes to make the vessel weatherly; and causes it, under judicious management, to turn, as it were, on a pivot. For this reason, the bow of a Cutter is frequently more full than might otherwise be thought proper for a swift-sailing vessel: nor would it answer so well were the line of floatation nearly parallel to the keel; but, spreading as it does aloft, especially towards the bow, whilst the *plus pressure* is reduced by the trim, the depression of the stern with the impulse of the aftermost sails, cause a proper counterbalance, and propel the vessel through the water with greater velocity than if otherwise constructed.

The principal points or requisites which are essential to the perfection of every vessel, are, that she shall be easy at sea; that is, go smoothly and easily through the water; rising to the sea when it runs high, and she under her courses, or lying to under a main sail; otherwise she will be in great danger of having her masts carried away; that she shall be stiff under sail, so as neither to pitch nor roll, and be able to carry a good sail, so as to double a cape, or get off from a lee-shore, with facility: that she shall steer well; and, with the utmost promptitude, answer to the least motion of her helm in all situations.

A ship should, also, not only sail well before the wind, when large, but, particularly, when close hauled, to keep a good wind, and not be leewardly, or fall off to leeward.

To unite, in perfection, and in one ship, all these desirable qualities, some of which are subversive of others, is impossible. We must therefore be satisfied if we gain that one in an eminent degree which forms the main point of the design; and, with obtaining so much of the others as may be practicable, consistently therewith: in order to effect which, it becomes necessary to enquire, what form will give a ship any one of these qualities, considering it as abstracted from all the rest; and this we shall consider in the following order:

1. Definitions and explanatory remarks on the motion of vessels.
2. Of imparting sufficient stability or stiffness.
3. To form a ship so as to steer well and quickly answer her helm.
4. To form a ship with such capacity as to carry her guns well above the water.
5. Of the form best adapted to go smoothly.
6. On the form best calculated to hold a good wind, &c.
7. General observations on the whole of the particulars above mentioned, and on the proportioning of ships' bodies.

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§ 2. DEFINITIONS AND EXPLANATORY REMARKS ON THE MOTION OF VESSELS, &C.

The Centre of Gravity of a ship, as we have already defined it*, is that point by which it may be suspended, and the parts remain in perfect equilibrium. It is, also, the centre of all the forces, or momenta, which press it vertically, or directly, downwards, towards the centre of the earth.

The Centre of Cavity or Displacement, is the centre of gravity of the hollow, or of that part of a ship's body which is immersed in the water; and, also, the centre of all the vertical force that the water exerts to support the vessel, or to raise it directly upwards. As this centre depends upon the shape of the body immersed, it of course varies with every inclination of the ship.

The Meta Centre, is that point above which the centre of gravity must by no means be placed; because, if it were, the vessel would overset. This centre, which has likewise been called the shifting centre, depends upon the situation of the centre of cavity; for it is that point where a vertical line drawn from the centre of cavity cuts a line passing through the centre of gravity, and being perpendicular to the keel.

The Centre of Motion, is that point upon which a vessel oscillates or rolls when put in motion. This centre is always in a line with the water's edge when the centre of gravity is even with, or below the surface of the water; but, whenever the centre of gravity is above the water's surface, the centre of gravity is then the centre of motion. This must be understood of bodies not perfectly circular; for, if circular and homogeneous, the centre of motion will be the centre of the circle.

The Line of Support, is the vertical or perpendicular line, supposed to pass through the centre of cavity, and intersecting a line drawn perpendicularly to the keel of the vessel, through the point called the Meta Centre.

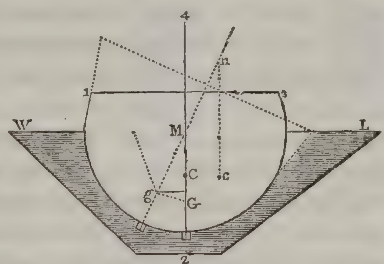
The Longitudinal Axis of a vessel is an imaginary line which passes horizontally from head to stern through the centre of gravity.

* See the article Centre of Gravity, &c. in Chapter I. of this Book.

The Vertical Axis, is an imaginary perpendicular line, drawn through the centre of gravity, when the vessel is in equilibrio.

The Transverse Axis, is an imaginary horizontal line, passing breadthwise from side to side, through the centre of gravity.

It is about these axes that every vessel in motion may be supposed to turn. In rolling, she may be supposed to oscillate on the *longitudinal axis;* in pitching, on the *transverse axis;* and in working, &c. to turn on her *vertical axis.*



In illustration of these definitions, let the segment of a circle 1 2 3 represent the midship section of a vessel's bottom; W L the line of floatation; M, the meta-centre, as well as the centre of motion, because this is a circle; C, the centre of cavity; G, the centre of gravity; and the line 2 4, the vertical axis of the vessel, which may be turned round the point M, as on a fulcrum, supported by the centre of cavity. By thus simply considering the vessel as a lever in the direction of her vertical axis, playing round her centre of motion, it is plain that, if the centre of gravity was placed above the point M, being the meta-centre too, the vessel would upset; therefore, that the ship may have stability, the centre of gravity must be below this point. And it may be observed, that the farther G is removed from the meta-centre, the greater must be its force, as the gravity then acts with a greater length of lever, considering the fulcrum of that lever to be at the centre of motion; or, if the weight at G be augmented, it will likewise increase the force; therefore the force of G may be expressed by multiplying the balance of weight, beneath the centre of motion, by the distance of the centre of gravity from the centre of motion.

The centres of cavity and motion (in circular bodies) will ever be in a line perpendicular to the horizon, but the centre of gravity may be either on one side or the other of this line. When such a body is at rest, the centre of gravity will be in this line; but, if in motion, it will be diverted from it. Thus the points M and C will always be perpendicular to W L; but the point G, by the body's rolling, may be on either side; for instance, at *g*. While G is perpendicularly beneath the centre of motion, its action can only tend to *preserve* this circular body in her erect position; if it be removed to either side, as to *g*, its action is to *return* it to the erect position; and this action increases as the distance G *g*, which is the sine of the angle of roll *g* M G, the distance M G being considered as the radius. Thus, to gain the force of gravity with any roll, as *g* M G, let the balance of weight beneath the centre of motion be multiplied by the sine of the angle of roll G *g*.

But the tendency to roll may be also diminished by the shape of the hull. For, let us suppose that the section be allowed more beam and increased by the dotted lines. Now, when this vessel is rolled over, it is plain that the cavity will be augmented towards the side L, of course its centre must remove towards L, say to c; and, if from c be erected a perpendicular to the horizon, it will cut the vertical axis at n, which will, in this case, be the meta-centre;

above which, if the centre of gravity were placed, the vessel would overset: but, as the centre of gravity is here below it at *g*, her stability will be increased by the increased distance of G from n, the meta-centre; and the vessel will oscillate on the point M as her centre of motion.

In order to judge of the state of equilibrium in a vessel at rest, let us take into consideration all the forces which act upon it: and, first, of the weight by which it is pressed downwards in the direction of the vertical axis. This force, as is evident, must be counterbalanced by all the efforts which the water exerts upon the surface of the immersed part. For, as the vessel occupies a hollow, or cavity, in the water, the quantity of water displaced must be equal in weight to the weight of the body, otherwise they could not be in equilibrio *.

Hence, therefore, is the first great principle upon which is founded the theory of the floating of bodies that swim upon the water: which is, that the immersed part must always be equal in volume to a mass of water of the same weight as that of the vessel; and, by which we determine the true weight of a vessel, by measuring the volume of its immersed part in the water.

From what has been said, the whole weight of the ship may be considered as united in its centre of gravity; so that, if it were suspended by a line fastened to this centre, the line would hang in a perpendicular position, as directed through the centre of gravity to the centre of the earth. A body which floats in a fluid is not, however, supported by its centre of gravity, but by the compression or vertical force of the surrounding water; and the centre of its support is the Centre of Cavity.

Now, as heavy bodies endeavour, by their gravity, to approach the centre of the earth, in a vertical line passing through their centres; so the pressure of fluids endeavours to carry bodies in a vertical, tending from the centre of the earth towards their surface. Therefore, in any submerged body at rest, these two opposite forces coincide in the same vertical, acting in a direction quite contrary to one another.

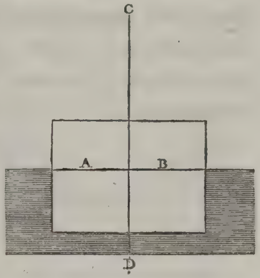
From the principles which have been explained, it results, that the stability or trim of a ship depends, chiefly, upon her construction, as considering the bottom to be homogeneous. This, however, can only happen when her cargo consists of the same materials throughout, as with corn, salt, or any species stowed in bulk, and when her hold is entirely filled. For, if a ship has not sufficient breadth to resist the effort of the wind upon her sails; or, if she is built too high, or too sharp in the floor, her centre of gravity will be too high, and she will be crank, or apt to overturn.

For the elucidation of these principles let us attend to the following plain and evident propositions.

PROPOSITION I. Every floating body is necessarily supported, or pressed upwards, by the fluid, with a force equal to its weight or pressure downwards; otherwise no body could remain at rest on a fluid, but would ascend or descend as the prevailing force determined.

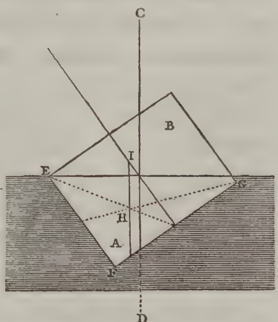
* See the article SPECIFIC GRAVITY, in the First Chapter, and the Hydrostatic Propositions, in the Second Chapter, of this Book.

PROPOSITION II. The momenta of all the forces with which a floating body presses on a fluid, and the momenta of the forces of the fluid which supports the floating body, are equal and contrary, and are resolved into the same right line perpendicular to the plane of the fluid. For, let the upright rectangle AB represent a floating body; it is plain that the centre of gravity is somewhere in the line CD *; but the centre of gravity is the point through which all the momenta of the forces of the body press on the fluid; and, if the momenta of the forces of the fluid were not in the line CD, but to the right or left of it the body would incline, which it does not; therefore, the pressures of the centres of gravity and support are resolved into the perpendicular CD.



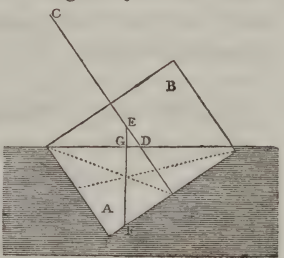
PROPOSITION III. Every floating body displaces a quantity of the fluid which supports it equal in weight to the floating body (by Proposition I;) and that part of the body which is immersed in the fluid represents the figure and quantity of displaced fluid; and the centre of gravity of the immersed body, supposed homogeneous, is the point through which the line of support to the floating body passes.

Let the rectangle AB represent a floating body inclined; by removing its centre of gravity from the perpendicular CD, the triangle EFG represents the figure and quantity of the displaced fluid: H is the centre of cavity or centre of gravity of the triangle. We say the line of support must necessarily pass through the point H, for otherwise the centre of gravity and support would not be in the same perpendicular right line HI, contrary to Proposition II.



PROPOSITION IV. If a floating body be inclined by any power which does not change the position of its centre of gravity, the line of support must necessarily pass between that power and the centre of gravity; and the force or momentum of that power is equal to the weight of the floating body multiplied into the distance of its centre of gravity from the line of support.

Let the rectangle AB represent a floating body inclined by the power C, without altering its centre of gravity D. We say the line of support EF must pass between D and C, and that the momentum of C, or its force multiplied into its distance CE, is equal to the momentum of D, or the weight of the floating body multiplied into its distance DE.

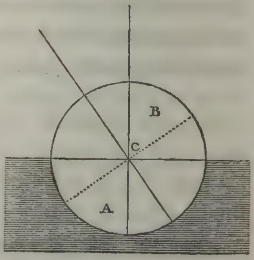


* See Chapter II. of Book II. on finding the Centre of Gravity, &c.

If the line of support F E does not pass between C and D, it must pass at either side. If it passes to the right of D, the body will overset; as the power C, and the gravity D are, on the same side, operating to incline it. If it passes to the left of C, the body will be rightened, as the power and weight operate to that effect; and, if the momenta of the power and gravity be not equal, the body will not remain at rest, but will incline more or less, as the power or weight prevail.

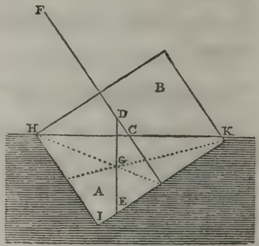
Corollary. It is plain that DG, or the distance from the centre of gravity to the line of support, multiplied into the weight of the body, is the measure of the stability of the body, or of its effort to righten itself when heeled, and that its stability is at that distance.

The point E is the place to which, if the centre of gravity of the floating body was raised, the inclination would be the same as with the power C, the centre of gravity remaining at D, and that point is *meta-centre;* but the meta-centre usually signifies a point to which, if the centre of gravity of a floating body be raised, the smallest lateral effort will make it incline.

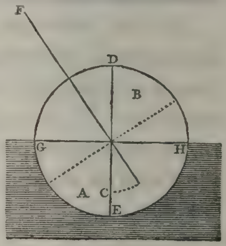


Thus, in a homogeneous cylinder AB, or sphere, the meta-centre and centre of gravity being always in the same point C, however the bodies are inclined, these bodies will have no stability.

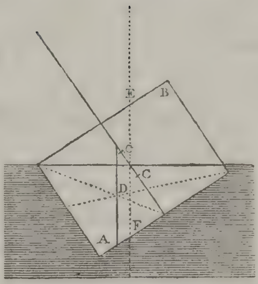
PROPOSITION V. The centre of gravity and line of support are separated, either by removing the line of support from the centre of gravity; or, by removing the centre of gravity from the line of support; or, by removing both the line of support and centre of gravity from the right line they were in before the floating body was inclined.



Case I. Let AB represent a floating body; its centre of gravity C in the line of floatation; the line of support D E passes through the point C, whilst the body is upright (by Proposition II.;) now incline the body with the power F; the centre of gravity remains at C, but (by Proposition III.) the line of support E D passes through G the centre of cavity, or centre of gravity of the immersed part of the body, supposed homogeneous; or, which is the same thing, of the displaced fluid H I K.



Case II. Let A B represent a floating body left to itself, its centre of gravity C, is in the line of support D E (by Proposition II.;) now incline the body with the power F, the centre of gravity C is removed from the line of support D E, which continues as before; the immersed body G H, not being changed in figure by the inclination.



Case III. Let A B represent an inclined floating body; its centre of gravity, C or c, either above or below the line of floatation: the line of support passes through D, and the centre of gravity of the body to e or C, out of the line E F, which they were in before the body inclined.

Corollary. It is plain, by inspecting the last figure, that the lower the centre of gravity is placed, the farther it is from the line of support, and consequently the greater will be the stability.

These three cases contain every variety of the principles of stability in floating bodies; for it is plain, that a floating body derives its stability either from its line of support, as in Case I, where the gravity is negative; or from its gravity, as in Case II, where the line of support is negative; or, as in Case III, where the line of support is positive, and the gravity positive or negative, as above or below the line of floatation.

From what has been advanced it will be clear, that the centre of gravity of a ship, has, in common with other bodies, a tendency towards the centre of the earth, whether on shore or afloat; and will descend, if it be not prevented from falling by the base or bottom that spreads without this point to support it. For, whenever a ship is laid on shore, and heels so much that the centre of gravity overhangs that part of a ship's bilge, upon the ground, that ought to support it, the ship will surely tumble over. And, when a ship is afloat, if ever she heels so much, that the centre of gravity goes farther over to one side than the centre of cavity, or the middle of the bearing part of the ship's body immersed in the water, the ship will overset: but, whilst the centre of cavity goes faster and farther over to the ship's side, in her motions, so as to keep without the perpendicular of the centre of gravity, in the manner that we have described, the ship will be supported; and the water will act upon the centre of cavity in the immersed body, with more or less power, in proportion to its distance without the centre of gravity, to bring the ship upright, when the acting force or power ceases, which occasioned the vessel to heel or turn. The comparative stability of different ships may be known by heaving them down; for it will be found that those which are low and broad will require so great a power, to heave them down, as to endanger the mast, (the *lever*, on which the strain lies,) owing to the position of the line of support, (the *prop* on which the vessel turns;) which will be proportionably without the centre of gravity. But, in vessels built high and narrow, the centre of gravity soon overhangs the centre of cavity, so that it becomes necessary to apply tackles, &c. to ease her down and *prevent oversetting* *.

* For some ingenious observations on this subject, and an account of some experiments relative to the centre of motion, &c. See Hutchinson on Naval Architecture and Seamanship, page 63, &c.

§ 3. OF THE STABILITY OR STIFFNESS OF SHIPS, &c.

The stability or stiffness of vessels, by which they are enabled to carry a sufficient quantity of sail, without danger or inconvenience, is no less essential to the safety of navigation than capacity: for, without it, a ship is totally disqualified for the purposes of war; in particular, by being unable to use her guns with effect, or carry a press of sail in case of emergency. This defect has not been uncommon in ships of war, an instance of which we shall give hereafter, although the means of prevention are as well ascertained, and as clearly demonstrable, as those which regulate capacity.

Although the wind may, in one sense, be said to constitute the power by which ships are moved forward in the sea, yet, if it acts on a vessel deficient in stability, the effect will be to incline the ship from the upright, rather than to propel it forward: stability is therefore not less necessary than the impulses of the wind are to the progressive motion of vessels.

From constantly observing that the performance of vessels at sea depends materially on their stability, both navigators and naval architects must, at all times, be desirous of discovering in what particular circumstances of construction this property consists, and according to what laws the stability is affected by any varieties that may be given to their forms, dimensions, and disposition of contents; which are determined, partly according to the skill and judgment of the constructor, and partly, as we shall shew, by adjustments after the vessel has been set afloat.

OF THE FORMS BEST ADAPTED FOR STABILITY.—It may be observed that, the forms given to the midship-bend of ships are always comprehended between the figure of a rectangle and that of a triangle; no ship being so full as the rectangle, nor so sharp as the triangle. Experiments, therefore, on the stability of these and the included figures would produce results by means of which the comparative stability of various forms may be estimated.

With this view, such experiments have been made by Charles Gore, Esq. of Weimar, whose name we have already had occasion respectfully to mention. This gentleman caused the four bodies to be made which are represented in the plate marked G. Of these bodies the specific gravity and capacity were precisely equal, although the forms differed extremely. Their materials were in quality the same, and they were balanced in such a manner as to be turned on their respective centres of gravity when afloat, by application of a small power, or weight.

This weight was fastened to a line whose end was made fast to the top of a stick, erected by way of mast in the centre of each body, and passed over a pulley in an opposite stantion which worked in a groove to admit of depression so as to be horizontal with the head of the mast when the figures became heeled or inclined. Thus, the power being always horizontally applied, was similar in effect, to the force of the wind. To keep the figures stationary, or counteract the inclination which the weight, as applied on the opposite side, had to draw the figures over, two fine lines were fastened to pivots driven into the ends of each figure at the centre of the line of floatation, and then fastened to hooks projecting from the sides of the cistern.

The results of the experiments were as exhibited on the engraving. The respective figures exceeded each other in stability as they stand numbered on the plate. But, it is to be observed, that, although figure 1 exceeded figure 2 in stability until the weights applied amounted to about thirteen pounds and a half, the excess with more than that weight was with figure 2. That figure 3 was, with every weight inferior in stability to figures 1 and 2; and figure 4 was, with every weight, inferior to all the others. Hence, it appears, that the form of a midship body, best adapted for stability only, is a rectangular or flat bottom with perpendicular sides; and, the next best adapted is a semi-circle with topsides perpendicular. But, as there exists much difficulty in constructing the rectangle with sufficient strength, besides its being very ill adapted to heavy seas; as, by the sudden descent in pitching, the bottom will strike the water at right-angles nearly, and sustain thereby a violent shock; besides that it would be leewardly under little sail. The semi-circle, or figure 2, would not only be inclinable to roll much, but would be deficient in capacity for many services. We may therefore recommend a midship body constructed in a form between the two as *most* applicable for ships in general; but, a midship body approaching more towards figure 3 or 4, would have the greatest advantage in point of velocity, and a greater length and breadth at the line of floatation might give even them sufficient stability.

To prove the degree of inclination that the windward side of these figures had, by suddenly cutting the line that suspended the weight when the figures were at their utmost inclination, with the top of the side to leeward as represented, and as even with the surface of the water, it was found that the inclination or roll was nearly in an inverse ratio to the stability, as the windward side of figure 1 heeled 29 degrees; figure 2, 33 degrees; figure 3, 27 degrees; and, figure 4, 23 degrees and a half.

VESSELS which have a sufficient degree of stability, arising from their construction, will certainly sail faster than others, which, in order to carry the same quantity of sail, require to be ballasted with a much greater weight; for the latter, so ballasted, will be much more liable to roll than the former.

A vessel that is broad and shallow has much more stiffness than one that is narrow and deep; and an increase of breadth will produce an increase of stability: but the expense of construction would also be materially increased, according to the usual mode of computation *, and the sailing of the ship may be retarded, as she certainly would be leewardly even under little sail, which ought to be particularly guarded against, especially in constructing large ships of war.

* The method in use to cast the tonnage, by multiplying the length of the keel by the extreme breadth, and the product by half the breadth, and dividing by 94, is very detrimental to that principle of construction which promises velocity; as the ship which is narrowest above, and widest and deepest below, will measure least in proportion to her real capacity, the reverse of which is necessary for fast sailing. For the most correct methods of finding the tonnage, see the Second Chapter of the following Book.

To increase the depth or draught of water, would lower the centre of gravity and increase the weight: this would operate against velocity, because the resistance is as the quantity of water to be removed; or, nearly, as the area of a thwartship section of the immersed part of the body at the midship bend. It would, at the same time, render the immersed body of a figure less proper to separate the line of support from the centre of gravity, so that the effect on one side would be in some measure destroyed on the other; and, by lowering the centre of gravity too much, the ship would labour excessively, and too large a draught of water is both dangerous and inexpedient.

But, by adding to the length the stability will be increased, the centre of gravity lowered if necessary, the form rendered at once fitter for separating the line of support from the centre of gravity, and finding less resistance from the fluid, especially when sailing on a wind, a case of the utmost importance.

Yet, although an increase of length would enable a vessel to carry the most sail, and sail the fastest, it must not be carried to an extreme; because, if so constructed, a vessel would neither tack nor veer so quickly; neither would she lift or rise in a sea like a shorter vessel; she would strain more, and be very liable to have the sea break over her. The influence of the rudder may be weakened and may even be totally lost. The greatest judgment is, therefore, required in proportioning the length, which may be proportionally greater in those vessels that generally navigate in the smoother seas, or are not intended to be deeply laden.

It is a well known fact that French ships have, in general, exceeded those of Britain in length, and have, in consequence, been excellent ships at sea, in point of sailing and stability.

In order, therefore, to construct a ship that shall be stiff under sail, or, in other words, have sufficient stability, we must determine to have a flat floor and sufficient length; the lower futtock pretty full; the upper futtock nearly straight; and breadth thrown out aloft to carry the main breadth pretty high; upper works as light and as low as possible; and so constructed as to keep the centre of gravity low. But, in ships of war, the centre of gravity can never be far removed from the load-water line, for could it be placed lower it is not to be desired; as the farther it is removed from the load-water line the motion of the ship become uneasy. The form of the immersed body and the weight of the ship are the chief terms in the composition of stability; and they are only to be attained in the requisite degree by full dimensions near the load water line with sufficient capacity. To prove this we shall relate an account of two experiments and then conclude this section.

As there is nothing of more importance to the well-being of a ship than its stability, the greatest attention must be given, in the construction, to the finding of the exact distance, between the meta-centre and centre of gravity, that every ship requires according to her form; the maximum of which is, that the ship shall not, by the length of lever, either become too stiff or be subject to sudden motion or rolling; nor, on the other hand, from the lever's being too short, that the vessel shall not be able to carry sail. To ascertain where the precise point is, would generally require much calculation.

Here it may be proper to notice, that the stability of many ships, however perfect in construction, may be materially injured by improper trim or an injudicious mode of stowage;

although, on the contrary, defects in the construction can be seldom rectified, to any considerable degree, by the stowage. To illustrate this point as clearly as possible, let us, in the first place, suppose a vessel, of the most correct construction and possessed of great stability, have the whole of her bottom filled with commodities, of the lightest nature, as high as her extreme breadth ; let her then receive as much lead, or other heavy matter, on board, as will bring her down to her load water mark. If the vessel were sent to sea in this condition, it would be next to a miracle when compelled to sail upon a wind, if she did not overset ; but, if the cargo were transposed, the same vessel might stand unrivalled in that very point wherein her deficiency had before appeared so conspicuous *.

Let the midship section, *figure* 2, in *plate H*, be referred to in elucidation of this case. If the centre of gravity be placed at D, it will enable the vessel to preserve a situation completely upright, notwithstanding a resistance against the side F Q. But, if the centre of gravity be raised too high, as to E, the resistance on the same side, F Q, acts in conjunction with the wind, and contributes with all its force to raise the windward side FQ out of its natural position ; thus the vessel becomes crank and unsafe. A proper medium must therefore be observed ; for, if the centre of gravity be raised too high, the vessel, as already shewn, will be disabled from carrying sail ; and, if placed too low, or too near the extremities either of head or stern, the ship will acquire too sudden a motion, which will not only cause her to roll but create other impediments. By giving, in the latter case, too great a momentum

* So extremely unacquainted with this point, or so inconsiderate relating to it, were even experienced seamen, a few years since, that a French vessel, captured in 1779, and considered as one of the finest forms ever seen at that time, and against which no objection, either from theory or experience was adduced, except that of being rather too short, was purchased by some merchants, taken immediately into dock, and lengthened. The vessel was then laden, under the inspection and direction of the master, for a West India Voyage ; the cargo was precisely of the description above given, and as injudiciously arranged. The consequence was, that the ship, having proceeded to sea on a fine calm day, without any apprehension being entertained of the consequences, was overtaken by a gale of wind within a very few hours, and very narrowly escaped oversetting. Having made for the first port, the master, under the first paroxysms of fear, was on the point of protesting against the vessel as unfit for sea, and probably would have done it, had not a person, possessing greater sagacity, been informed of the circumstance, and advised the transposition of the cargo. The effect was considered as almost magical, and the master put to sea in perfect confidence, though somewhat ashamed of his former absurdity.

Another instance of the importance of correct trim, with which we have been made acquainted is, that, in or about the year abovementioned, 1779, a British frigate of 38 guns, and one of the first vessels built in England of that enlarged and superior class, was constructed according to a form which was considered by the best judges as likely to be conducive to velocity as well as to stability. The vessel, however, when launched and fitted for sea, was found by no means to answer the expectations of her constructor ; and she remained in this state of disgrace for some weeks, until, after a variety of ineffectual experiments had been tried, it was discovered, perhaps accidentally, that the simple operation of running the two bow guns completely aft, entirely effected the desired purpose, and enabled the frigate to sail as well as any, and superior to many, of her own class, which were then in the service. As so trivial a variation in the water line, or rather, in the disposition of the weight with which a vessel is loaded, can effect so material an alteration, it seems reasonable to infer that, in other instances, wherein the judgment of the architect has been impeached, the charge may have been hastily and unfairly made. *(Charnock's History of Marine Architecture.)*

or weight to the head or stern the vessel will be apt to pitch, and therefore subject to the most dangerous movements *.

We have now to shew, in the second place, that defects in the construction can seldom be rectified by stowage ; and that, therefore, a prevailing opinion among naval officers and others, namely, that the stability *depends chiefly*, on the stowage of the hold, is not well founded. In order to shew that a very great change in that respect will sometimes produce but a very trifling difference in the stability, we shall quote a professional author of merit, M. de Romme, in his book, *L'Art de la Marine* †, page 105. " As to the position of the centre of gravity, no doubt but it may vary, yet the limits to which it is confined are very straight, especially in ships of war, a recent example of which was seen in the Scipio of 74 guns, armed for the first time in 1779, and hardly in the Road before she was suspected of instability. It was important, in

* The ingenious Mr. Falconer, in his *Marine Dictionary*, has observed, that, " the stiffness of a ship, or quality to carry sail without danger of overturning, depends very much on the stowage of the hold ; and that, if the centre of gravity be lowered, her stability will be increased in proportion. It is, he observes, a general maxim among mariners, that a ship will not carry sufficient sail till she is laden so deep that the surface of the water may glance on her extreme breadth amidships. She must therefore have a great deal of weight, as ballast, &c. to bring her to this situation, which is called a *good sailing trim*.

" Several circumstances are also to be particularly considered with regard to the quality, weight, and stowage, of the ballast. The centre of gravity being placed too high, will render the ship incapable of carrying a sufficient quantity of sail ; and, by having it too low, she will be in danger of rolling away her masts. When it is placed too far forward, the ship will pitch and labour heavily ; and, when too far aft, she will occasionally be exposed to the dangerous circumstance of a pooping sea, &c."

† In noticing here the work of M. de Romme, it may not be improper to observe that the efforts and enquiries of this gentleman, with respect to the theory of ship-building, have not, invariably, been attended with success. M. de Romme made a number of experiments in the port of Rochefort, with bodies measuring thirteen or fourteen feet in length, and five in breadth, from which he inferred that he had established the following facts.

" 1. That, in a floating body, an arc experiences the same degree of resistance as the chord ; and that, consequently, a spherical surface is resisted with the same force as a perpendicular plane.

" 2. That, having made two vessels, the one an exact model (in the proportion of *one* to *twelve*) of a 74 gun ship, and the other with the same midship-bend, stem, and stern-post, as a 74 gun ship, but with water lines straight instead of curved ; he found that these two bodies, notwithstanding the enormous difference of their capacities, experienced the same degree of resistance. M. de Romme likewise supposed, that he had discovered, that the body advanced with the same celerity when drawn by the head as when drawn by the stern ; of course, that it was indifferent which end moved foremost, &c."

" But what seemed to prove beyond all doubt that the particular form of the bow facilitates little, if at all, the dividing of the fluid, was, that having cut the two models in half, and joined the head of the one to the after part of the other, and *vice versa*, these two irregular bodies appeared to experience the same degree of resistance when drawn by the head as when drawn by the stern."

Let these experiments, which have been productive of some false science, be compared with those of the Society for the Improvement of Naval Architecture. Their inaccuracy will then be too palpable to need a comment. They are, however, useful, as they tend to shew the essential necessity of the most strict investigation in experiments of this nature ; and, as they may caution others, who, like M. de Romme, may be diligent enquirers after truth, to avoid the errors into which he has been led, by an incorrect process. They tend to shew, at the same time, the great value of the English experiments.

time of war, to clear up these doubts, and to make the necessary experiments to prove this dangerous defect, if it existed. First the lower deck guns were run out on one side, while housed on the other, which heeled the ship thirteen inches: the ship's company were then ordered to their quarters at the side on which the guns were out, and this addition of weight increased the inclination to twenty-four inches. After these essays the sails were set, and, in fine weather, the ship was found so crank as to render the use of the lower deck guns difficult and dangerous: her instability being thus proved, she was ordered into port to be remedied.

"Opinions varied as to the cause of the defect; some persons imagined it to proceed from the form of the hull, others from the ill arrangement of her stowage. The first Engineer was ordered to attend at Rochefort, and direct the choice of measures to give the Scipio, as well as two other ships, the Pluto and Hercules, built from the same moulds, the stability they wanted. He judged that new stowage would remedy the defect, and his opinion was adopted by the Marine Council. The Scipio was unloaded and again stowed, under the direction of the Chief Engineer. In her first stowage she had eighty-four tons of iron and one hundred tons of stone ballast, and was re-loaded with one hundred and ninety-eight tons of iron and one hundred and twenty-two tons of stone ballast; and, as her draught of water, or displacement, could not be altered, it was necessary to diminish one hundred and thirty tons of water, in order to preserve the same load water line; by these means one hundred and thirty-six tons were placed, in the second loading, eight feet lower than in the first; yet, when the ship was completed with the new arrangement of stowage, she was found precisely as deficient as before, inclining twenty-four inches with the men at quarters and guns out on one side. She was afterwards doubled with light wood to the thickness of a foot at the extreme breadth, and ten feet under water, decreasing to four inches length and depthways; which corrected the defect.

M. de Romme has judiciously observed, that the defect of instability was not so much owing to a want of extreme breadth, as several other seventy-four gun-ships had the same, or even less; but, in diminishing the breadth at the plane of floatation too quickly fore and aft, which at once reduced the capacity and became injurious to the position of the line of support *.

It is certain that this change of place, in the centre of gravity, which lowered it nearly five inches, must have contributed to increase the stability, and have occasioned nearly a difference of three inches in the greatest inclination; but, as the experiment when the men are stationed at quarters is liable to much irregularity, an error of this magnitude is to be accounted for from the men's running to the side, to mark more strongly the defect of a bad ship.

Experiments should be made with ships of every description, especially ships of war, at sea, in order to produce a true theory of naval architecture. Without these the science will always remain imperfect. Every voyage might be considered as an experiment. Systems to which the name has formerly been given do not deserve the appellation; for, in the language of

* A French 36 pounder weighs, with carriage, &c. four and a half French tons; and their increased length causes their centres of gravity, when run out, to be removed four feet and a half; so that the momentum produced by running out the lower deck guns of a French 74, with the opposite side housed, is more than double the momentum for an English 74, in the same circumstance.

a most ingenious writer on this subject, "a theory which does not agree with experiment does not deserve the name of theory."

Several experiments were made, by order of the late Admiral Leveson Gower, to try the relative stability of several British ships of war, by heeling them with their lower deck guns out on one side, and housed on the other; and afterwards with the men at their quarters, the guns remaining as above. Among these were, the Formidable and Barfleur, of 98 guns, and the Bombay Castle, of 74 guns, whose draughts of water were as follow:

		Ft. In.		Ft. In.		Ft. In.
Formidable 98 guns	Afore	22.0	Barfleur 98 guns	23.10	Bombay Castle 74 guns	21.0½
	Abaft	23.3		23.11		22.9
Lowest port above water		5.6		4.6		5.1½
Heeled by the guns only		0.3½		0.3		0.3
Ditto with men at quarters		1.2		1.0		0.8
Weight, or Displacement		3150 Tons*		3360 Tons		2700 Tons.

The three ships have the same number and weight of guns on the lower gun-deck; therefore the momentum of the guns, whether quite exact or not, does not signify, as any error will not have partial influence. We suppose each gun and carriage, &c. together to weigh three tons, and allow three feet removal when the gun is run out; and, as there are fourteen guns run out in each ship, the equal momenta for them is $3 \times 3 \times 14$, or 126 tons at 3 feet, the weight on one side, the balance is 42 tons at three feet distance from the support; and, at the other, in the Formidable, 3150 tons, at 48 hundredths of an inch (less than half an inch) which will be found to balance 42 tons at 3 feet:—For the Barfleur 3360 tons, at 45 hundredths of an inch, which will balance 42 tons at three feet: For the Bombay Castle, 2700 tons at 56 hundredths of an inch, which will balance 42 tons at 3 feet †.

Having found the distance at which each centre of gravity is separated from the line of support, and which, in these small inclinations, will be the same as the sine of the angle; the co-sine, or distance of the centre of gravity from the meta-centre may be readily known, and will be found to be,

* The difference in the mean draught of water of the Formidable and Barfleur, 15 inches, gives at least 210 tons difference of weight. Both ships have similar dimensions nearly, and are supposed on an even keel.

† In order to make this subject perfectly clear to such of our readers as may not be much in the habit of making calculations, we subjoin the following note. The momentum of the guns is found, by multiplying the number and weight of the guns, &c. together, and the product by the distance from the original position or point of support. In the present case, the number of guns being 14; the weight of each, 3 tons; and distance from the point of support, 3 feet; $3 \times 3 \times 14$ is equal to 126 tons, the momentum.

Now, as the distance from the point of support above is expressed in 100ths of an inch, which are equal to so many 1200ths of a foot; and, as forty-eight 100ths of an inch are equal to forty-eight 1200ths of a foot, (because there are 12 inches in a foot) therefore, by multiplying the number of tons in the displacement, (say 3150) by the numerator 48, and dividing by the denominator 1200, the product will be equal to 126. Consequently, the momentum of the guns of a ship, whose displacement is 3150 tons, when they are only at forty-eight 100ths of an inch from the point of support, is equal to that of the guns of a ship which weigh altogether 42 tons at the distance of three feet.

For the methods of finding the centres of displacement, &c. see Chapter II. of the following book.

	Ft. In.	
For the Formidable's centre of gravity	$3.5\frac{1}{10}$	Below the Meta-Centre.
Barfleur's	$3.9\frac{2}{10}$	
Bombay Castle's	$4.5\frac{7}{10}$	

When the Formidable and Barfleur were farther inclined by the men at quarters, the Barfleur continued to have one seventh more stability than the Formidable, which proves that the Formidable's centre of gravity was above the line of floatation; for otherwise, as her immersed body was better calculated to separate the line of support from the centre of gravity than the Barfleur's, she would have inclined less, proportionably, if the centre of gravity had not acted against her stability: One hundred tons of iron ballast at the keelson would have increased her draught of water only six inches, and have given her more stability than the Barfleur; leaving her the advantage of six inches more height for her ports, and nearly thirty-four square feet less resistance at her midship bend. Thus, it is demonstrable, that those ships should have no more stone or shingle ballast than is necessary for the ground tier, and should have above two hundred tons of iron; nor would there be any danger of their being laboursome, as their centre of gravity would be but at the line of floatation, or load water line. The same regulation would prevail with the first rates.

The Bombay Castle is certainly stiff enough; yet there is no doubt but that her lower deck guns might have been placed six inches higher without any detriment whatever to the ship, and with her ports at a reasonable height from the water *.

§ 4. TO FORM A SHIP SO AS TO STEER WELL, AND QUICKLY ANSWER HER HELM.

In order that a ship may steer well, and quickly answer her helm, the Wing Transom should be carried pretty *high*, or about three-fourths of the height of the top-timber line in midships, and the fashion-pieces well formed and not full below the load-water line, but so that the form of the vessel may come very clean, or sharp, as it approaches the keel aft; the midship frame should be placed about five-twelfths of the length from forward, and the greater the proportional length of the ship is to her breadth, the midship bend should be proportionally farther forward; as the sloping, or angles, of the water lines at the stem and stern are necessarily sharper or more acute in a long than in a short ship; that is to say, proportioned to the breadth: and it will further correct the slowness observed in the evolutions of long ships, as the centre of gravity will necessarily be farther forward, and give more length to the lever to which the force of the rudder is applied. The ship to draw rather more water abaft than afore; to have her bow rake about three-tenths of her extreme breadth, and the stern post to rake between one and two inches in every foot of the length of the post; the quarter deck and forecastle, and all the upper works, to be kept as light and low as possible; all of which certainly tend to make a ship

* See "Collection of Papers on Naval Architecture," Vol. II. page 12.

go well, and quickly answer her helm; for a ship that goes easily and quickly will always steer well; and, possessing this quality in perfection, she will stay, veer, and incline to the larboard or to the starboard promptly. It is evident, that the effect of the rudder must depend, in great measure, on the cleanness of the vessel's run, so that the fluid shall have an unimpeded passage to it, whereby its inclination shall have the greatest effect on the water.

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§ 5. TO FORM A SHIP WITH SUCH CAPACITY AS TO CARRY HER GUNS WELL ABOVE THE WATER.

That a ship may carry her guns well upon the water, a long floor timber will be necessary, and not much rising; the midship frame to be very full; upper futtocks near a straight; upper works to be very light, and the wing transom not placed too high; all of which will combine to make a ship carry her guns well out of the water.

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§ 6. OF THE FORM BEST ADAPTED TO GO SMOOTHLY.

That a ship may go smoothly through the water, it will be necessary for her to be so proportioned as not to be subject to those violent and irregular movements which tend to impede the velocity, and, by a force of strain, to destroy the vessel. To prevent rolling, great proportional breadth, and sides nearly upright towards the plane of floatation, are favourable. To prevent pitching hard, give her a long keel, a long floor, with little rising afore and abaft; the displacement of the fore body to be duly proportioned to that of the after body, and hollow water lines forward to be carefully avoided in the construction *. In this case, correct stowage will be a powerful auxiliary to the accuracy of construction. For if, to prevent rolling, all the heavier bodies be removed as far as possible, from the longitudinal axis; and, to prevent pitching, if all such bodies be stowed as much as possible towards the transverse axis of the ship; these movements will be found to prevail considerably less than under the circumstances of a different mode of construction or stowage; and the advantages will be great, not merely in obviating the quick oscillatory movements of rolling, but also the accelerated, or pitching, motions fore and aft, so much more to be dreaded, occasioned by hollow seas, hollow water lines, and great weights at the extremities of the vessel.

A due regard to these particulars, will certainly be the means of causing a ship to go the more smoothly through the water.

* By "*hollow water lines*" are meant, such water lines as curve inwards.

A remark, made by a late writer on water lines, states, that their fairness can, in no respect, be a matter of great importance, since they are all formed on the supposition that the vessel always floats upright in the water; a position she can seldom be in when under sail; and, since the immersed part must alter its form as often as it alters its position. Of this remark, granting the latter part of it, we may observe, that it is also as certain that, in the body of every vessel, of which the horizontal lines, vertical lines, and sections, are fair in the construction, will also produce fair lines in any position: and the form of the water lines, however altered by the inclination of the vessel, may be drawn, and will prove the assertion to be false.

§ 7. ON THE FORM BEST CALCULATED TO HOLD A GOOD WIND, &c.

THE quality of being weatherly, or of holding a wind well, may be defined as the power which a vessel possesses of keeping her course with the least possible deflection when opposed by an adverse wind. This quality may be either effected by the peculiar form of the hull itself, or by artificial auxiliaries, as lee boards, additional keels, &c.

A full-bodied vessel, as before noticed, is infinitely less capable of holding a direct course than one of a sharper description. The reason is obvious. The opposition to the water is, in the former instance, oblique; in the latter it approaches more nearly to a direct plane.

It is an observation of a very ingenious writer, heretofore quoted, that, if it were possible to saw a vessel longitudinally down the middle; after which, having carefully planked up and caulked the side so cut, so that it should be water tight, to add such a counterbalance by means of an outrigger, constructed according to the Indian system, sufficient to balance or become equivalent to the support taken away; such a vessel would undoubtedly possess velocity and stability in a far superior degree to what it did when in its perfect state. The reason is almost too obvious to render any explanation necessary: for, it is clear, that, in this case, one half of the head resistance would be taken away, and, therefore, the velocity, if the impulse continues the same, becomes increased in a ratio equal to the diminution of the opposition. In addition to this, the fluid acting horizontally will impede the passage of a perpendicular flat surface through it much more forcibly than it would if acting obliquely on a convex surface; and it follows, that such a vessel would suffer less deflection from its intended course than one built agreeably to the usual figure. This case seems to combine all the principles on which the quality of holding the wind well is founded.

To give a ship, on the usual construction, that form which shall make her weatherly, or, in other words, to keep a good wind and sail swiftly, she must have a great length and good depth of keel; her breadth not too great; her sides not kept parallel, or the extreme breadth not continued, too far aft; as this would be against velocity. Every succeeding water line should be more delicate in approaching toward the keel; and not hollow forward, as before observed. If a good depth in hold be given, the ship will, of course, have a short floor and a great rising; and, as she will feel great resistance sideways, or on her broadside, with little resistance a-head, she will, consequently, sail fast, and not fall much to leeward.

§ 8. OBSERVATIONS ON THE WHOLE OF THE PARTICULARS DESCRIBED IN THE FOREGOING SECTIONS, AND ON THE PROPORTIONING OF SHIPS' BODIES IN GENERAL.

IT may be urged that it is not possible to make a ship at once carry her guns well above water, carry a good sail, and be a fast sailer; because it would require a very full bottom to gain the two former qualities, and a sharp one to gain the latter; but, if we consider, that a full ship will carry a great deal more sail than a sharp one, we may perceive the possibility of constructing the body so as to possess these three qualities, and likewise to steer well; in order to which a good length must be given.

From what we have said under this head the Reader may, perhaps, infer, that the four qualities above mentioned may be so united that each of them may be discerned in some degree of eminence: we shall therefore repeat a former observation; namely, that all of them cannot possibly be existent in any one body to a degree of perfection. We must, therefore, while we retain a portion of each, give the superiority to that which is most consistent with the purposes for which the ship is peculiarly designed. Some very eminent geometricians have, indeed, endeavoured to find the form of a solid which should possess all these properties, and meet with the least resistance in dividing the fluid; but they have not been able to reduce their theory to practice, by reason of the different positions assumed by a ship when under sail. Many who have despaired of establishing these points by mathematical rules, have applied themselves wholly to their own local observations and experience, which may, and doubtless have, in some cases, served as a substitute for more correct science. Yet, although it may in this manner have been discovered that some vessels have had bad qualities from which others were exempt, and the contrary, it could not be determined wherein the fault, or the advantage, lay; whether in the Hull, in the Sails, or in the Rigging. Hence no remedy could be applied, no certain rule deduced.

There are several ships, in the British navy, which have answered the services for which they were designed particularly well, and have gained the unanimous applause of those who have sailed in them. Those ships have been copied, and from their models others have been constructed. This method cannot, however, be correct. For, even suppose that it were possible to find such a body as would give entire satisfaction, and have every good quality that should be necessary to answer the purposes proposed, yet this ought, by no means, to be considered as a standard whereby all other ships, of varying dimensions, should be built: for, it is obvious, that, although we may have a first rate, of 100 guns, which has, by experience, been found to be a good ship in all respects; yet we should find ourselves very much deceived if we were to build a fifth rate, of 20 guns, by giving all the parts the same proportion to each other as those of the larger ship.

No doubt can, however, be entertained, but that experience would long ere this have produced invariable and permanent rules for the best forms of ships' bodies, had that attention been generally bestowed on the subject which it so well deserves; although absolute perfection may be scarcely attainable. Practice alone is insufficient in many cases; and the want of science in most of those who have the best opportunities of combining theoretic principles with the deductions of experience, makes much against the advancement of the art.

Upon the other hand, no practical rules can, as yet, be drawn from the reasonings of the mathematicians, for the most perfect form of a ship; and, we may conclude, since the very first abilities have been exercised upon the subject, that such a form cannot be determined by rules that will admit of mathematical demonstration. Hence it is, that the builders, finding but little assistance from that class of the learned, have confined themselves almost solely to the results of actual practice: and, although they have not ascertained any particular form which may be considered as a general standard for all ships of the same burthen, or designed for the same service, yet in many points they agree. For instance, in ships of war, of the same rate, the principal dimensions are nearly the same; and, in all, the midship frame is nearer to the fore part than to the after part of the vessel.

It is greatly to be wished that we could lay down invariable rules in all cases; but, after examining the writings of every respectable author who has treated on the subject, we still remain deficient in several important points. Indeed, considering the various properties, in some cases so diametrically opposite to each other, it is hardly to be expected that we should have attained them. Besides, the different seas and different services in which vessels may be employed will require forms as different. The Flying Proa of the Southern Ocean, and the unwieldy Catt of Scandinavia, are, perhaps, equally suited to the climates and purposes for which they are designed.

Theory alone, without actual experiment and daily practice, seems insufficient to reduce this complicated art to a regular system; and Practice alone will also be deficient, although not in an equal degree; because continued practice may produce theory. Experience, undirected by genuine science, may lead, and frequently does lead, to useful improvements; but the progress of such improvements is, generally, slow, indirect, and too frequently unsatisfactory. But, when scientific reasons can be assigned for the advantages which result from common practice, they tend to satisfy the mind, make us more attentive, and impart a pleasure in the prosecution of our labours.

We now proceed to give some general observations on the proportioning of ships' bodies.

GENERAL OBSERVATIONS TO BE CONSIDERED IN THE PROPORTIONING OF SHIPS' BODIES.

THE Midship-bend, or extreme breadth of a vessel, may either be placed in the middle of its length, or farther aft or farther forward, whilst the quantity of bulk shall remain the same in the whole. By placing it farther aft, the lines that form the fore end of the ship will run the nearer to a parallel with the keel, and, consequently, may appear to give the less absolute resistance to the opposing water: but, it has long since been found, by experience, that the place of the midship frame of all vessels should be afore the middle of their length, as the fore part of the ship will thereby become fuller than the after part: and, consequently, a ship so formed, after having once opened a column of water, will meet with less resistance in passing through it. Other advantages attend the forward position of the midship bend; the ship will lift easier in a heavy sea, and, in that case, necessarily sail faster; she will have more capacity, and be less liable to hog or break her sheer*; and, what is of very material advantage, will

* The means of preventing a ship's hogging will be fully considered when we come to treat of the actual construction.

admit the foremast to be placed farther aft; for the more acute the bow is, the greater quantity of head sail is required, (though less able to support it,) that the centre of effort of the sails may meet the resistance of the water on the bow when sailing by the wind.

Of the Experiments described in the preceding chapter, those which relate to the bodies, figure 4 to figure 10, in plate D, and several others in plate E, are more particularly calculated to shew the proper situation of the midship bend relatively to the celerity of a vessel. In addition to what has been there explained, may be added, that, upon the more straight part of a ship's sides, and the declining part of her bottom, it has been frequently observed, that the fluid, owing to its adhesive quality, is displaced in a very slight degree: this appears from the grass that grows on the sides of the ship's bottom; it may be seen to grow right out, and wave backwards and forwards from the sides of the bottom, as if the water had no motion, when at the same time the ship may be sailing four or five knots an hour. That there is a considerable adhesion of the water, even when the ship's bottom is clean, has been already sufficiently shewn; but much more so when the bottom is foul. This atmosphere, or carrying part of the water along with the ship, is what we have called the friction, or lateral pressure, of the water, and is to be considered, and must be taken connectively, with the account of the resistance.

Supposing that a ship had all the perfections in her dimensions, and the midship bend placed near the middle, but built sharp at the ends; if we consider the weight of the foremast and bowsprit, with their rigging and sails, and the weight of the anchors at the bows, we may easily conceive that, with the pressure of the wind upon the sails, the support in or bearings of the fore body would be insufficient to prevent it from pressing down into the hollow of every sea. The support would only be in the body farther aft, and this would tend to plunge her head still deeper, and retard the velocity.

Another consideration is, that the quantity of opposing surface in the bottom should not be equal forward to the quantity of surface abaft; for, if it were, the ship must be trimmed greatly by the stern, or her rudder would not command her to bear up in a gale of wind. When a ship is pressed with sail, the water is forced up at the bow above the horizontal, and the ship likewise pressed down, which amounts nearly to the same, with respect to her helm, as if the ship was trimmed by the head: again, ships that carry their tiller near the middle in light winds, require it more a-weather when the wind blows.

Now, it is plain, that the placing of the midship bend is of the utmost consequence in the construction of a ship's body; and, it appears very clear, from what has been said, that a ship with the midship bend placed nearer forward than aft, which will consequently make the fore body more full, will best answer every purpose, especially that of velocity*.

* It has been remarked by an ingenious writer, that, " In our attempts to accelerate the velocity of moving bodies, nature happily seconds our efforts. For, the greater the velocity with which any body moves, the greater is its tendency to continue in motion; and the less obstructed, the easier is that motion communicated, and the greater effect will that tendency have: and, it merits observation, that this tendency will operate in the proper direction, not only when the moving power is in that direction, but even when it acts obliquely, if the body or vessel is so constructed as to be much less resisted in moving, and consequently to have a much greater tendency to move, in the line of the keel or proper direction, than in a direction perpendicular to, or deviating from, it. On which account, as well as

And, although it is plain, that, by so doing, the entrance of the ship will be the more full, and present, apparently, more absolute force against the current of water than when the midship bend is placed nearer to the middle of the ship; yet, by moving that bend nearer to the fore end of the ship, the body will decline horizontally so much the quicker, and part of the effect of that resistance caused by the lateral pressure of the water will be taken off; which must, certainly, be of more service to the velocity than what is lost by making the fore part of the ship somewhat fuller; and seems to promise the connection of capacity and velocity, the two great objects to be pursued in the construction of ships' bodies.

And we may now venture to assert, upon the premises which we have adduced, that, by carrying the midship bend forward, we shall gain not only in point of velocity, but likewise in point of steerage, which will be a double advantage.

In addition to what has been said with regard to the sailing trim of a vessel, in the first section of this chapter, it may be observed, that, however advantageous it may be thought for a vessel to sail on an even keel, yet, in the opinion of many persons, the extreme breadth of a ship should always be higher abaft than in midships, by about one sixth of the load draught of water; which, in consequence, will make the ship draw more water abaft than afore. The reason assigned is, that, as the fore part cannot so readily divide the water, when the keel is parallel to the surface as when it is inclined to the stern, the vessel will sail better: and this is the general opinion of seamen, who have frequently remarked, that it is necessary to make her draw more water abaft than afore; whereby they, at least, gain this advantage, that the ship will answer her helm better: but, it will, in construction, occasion the decks to be raised higher abaft than afore.

That the extreme breadth should also be raised considerably more afore than abaft, is recommended for these reasons:—when a ship is close hauled by the wind, and lies much over, the weather side will lose much of the breadth; whereas, on the contrary, the lee side will gain considerably; the ship then displaces a greater quantity of water on the lee side, and, according to the manner in which fluids act, should be supported with greater force, and, of consequence, be able to carry the greater sail. Hence, it is plain, that, by raising the breadths, we keep them as a reserve to be used when a ship stands most in need of relief, that is, when she lies most over.

It may here be remarked, that flat-floored ships do not require their breadths to be raised so high afore and abaft; for, carrying all the weight of their cargo low, they are thereby made capable of carrying a greater stress of sail.

A ship may be built to a precise draught of water, by which the construction will be founded upon true principles; but, when a ship is not built to one precise draught more than another, it will be a very difficult, and one of the most complex, questions in naval architecture to deter-

others, it is a matter of great consequence, that vessels should be so formed, as, when moving, to meet with as much lateral and as little forward resistance as possible; and it is, undoubtedly, of the utmost importance to employ every effectual means for increasing a tendency, valuable not only on account of its augmenting velocity at no expense of force, or without any augmentation of the impelling power; but, likewise, on account of its operating in the right direction, or nearly so, under most circumstances, in a vessel properly constructed."—*Gordon on Naval Architecture.*

mine this point. Some will imagine that no more is to be done than to make the ship swim in the water, so as to be capable of carrying the greatest sail; but, when a ship is very deep in the water, it will greatly increase the resistance, and, consequently, be very prejudicial to her sailing; the resistance must, however, be calculated, not absolutely, but relatively, and in proportion to the sail she spreads.

In corroboration of the principles explained and inculcated in the preceding sections, we subjoin the following paper, written by Sir George Shee, *Bart.* Member of the Royal Irish Academy; and some particular Remarks on the Formation of Merchant Shipping, by Mr. William Hutchinson.

§ 9. OBSERVATIONS ON THE CONSTRUCTION OF SHIPS: BY SIR GEORGE SHEE, BART. M.R.I.A.

From the Transactions of the Royal Irish Academy.

"I was first led to suspect that the construction of ships built in Europe admitted of improvement, by observing, that vessels employed on the River Ganges, and on different coasts of India, carried great burdens, in proportion to their dimensions; and, on examining them, I found that, however widely they differed from each other in appearance, great expansion was common to them all. The vessels of the Ganges, it is true, being constructed to move at times in shallow water, were not, I found, well calculated to sail near the wind; but this defect, I knew, could be remedied; and it was sufficient for my purpose to ascertain the fact, that, when heavily laden, they could be moved with greater velocity than vessels on the European construction, of the same burden, could be by an equal impulse, with ballast only on board.

"The opinion I had thus formed was strengthened, in the course of a voyage I made from Bengal to England. Observing that the Rodney, a company's ship, which I was on board of, appeared longer, and sailed faster, than other Indiamen, I made enquiry as to her construction; and was informed that, on laying her keel, she had been intended for a ship of much more considerable burden; but that, owing to a temporary scarcity of timber, all her dimensions had been abridged, except that her length was suffered to remain, and consequently to exceed, by some feet, the usual proportion. On our arrival in the Channel, with the wind about a point before the beam, we overtook a fleet of West Indiamen, and we outsailed them with such facility, that they might almost have been supposed water-logged.

"These observations, with many others, led me to bestow more attention than I had before paid, to an examination of the mechanical principles applied to the building of ships; and the more I extended my enquiries, the more I was convinced that their construction was defective. Had, however, my conclusions not been strengthened by previous observation, I should not have thought them worthy of attention; for I am myself so much an infidel in theoretic systems in general, that I offer considerable violence to my mind, whenever I subscribe to their truth, unless confirmed by something like experimental proof; and I should not therefore expect from others much attention to remarks merely theoretic.

"A glaring defect in ships employed in transporting merchandize is, that they draw too much water, or are constructed too deep. It is well known that every floating body propelled, must, in its progress, displace a body of water equal in weight to itself, and equal in bulk to the part situated below the surface; and, that this operation must be repeated as often as the body moved advances a distance equal to its own length. Now, as the line of least resistance from the water displaced is upwards, it follows, that the force necessary for its removal must be great, in proportion to the distance of any part of it from the surface; and hence arises the facility with which vessels drawing little water are moved, even when the burden they carry is considerable.

"Another defect in merchant vessels is, that they are too short. The progress of a ship that wants length is impeded by perpetual ascent and descent, even in water but moderately agitated; while one that has it proceeds with little more than direct motion. But this is not the only objection to want of length. The tendency of the upper sails of a ship is, not only to propel horizontally, but in a very considerable degree to press down the head and elevate the stern, as will appear evident, when it is considered that the mast is acted upon as a lever; the upper deck is the fulcrum, and the parts above and below it the two arms. Now the action of the wind that fills the upper sails is nearly upon the point of the long arm, and the degree of resistance to the depressing force so caused, is determined by the length of the line from one extreme horizontal point of the ship to the other; when, therefore, this line is short, in proportion to the height of mast, the effect is not only evident in a high or rippling sea, with the wind fair and strong, but, even in smooth water, the vessel, particularly if small, proceeds with evident deviation from the horizontal position which her hull is intended to preserve, as well when in motion as at anchor; and, by this means, the points of direct resistance are multiplied, as the height of the frothy wave at the bows of such vessels in their progress, or the disproportion of that wave to their velocity, shape, and size, evidently shews.

"A third defect, not less striking than these, is, that the vessels I mention are too narrow. A few feet of length add little to the size of ships, as to burden, but a single foot in breadth increases prodigiously their capacity to sustain weight. The shape of merchant vessels in general may be said, from its tendency, to resemble an extended wedge, perpendicularly placed; every ton additional weight presses them down considerably, and, from the practice of overloading them, in order to proportion their burden to their sailing, charges, and original cost, they commonly proceed on a voyage almost buried in the water. To this circumstance alone, the loss of numbers of them may be ascribed; for a captain must be positive that the danger is excessive, before he can hold himself justified in attempting to lighten the ship; and, in situations the most perilous, this is often found impracticable.

"The remedy for these defects is easily stated, but the practicability of applying it requires explanation; as inveterate prejudices in the minds of ship builders are to be opposed, and strong prepossessions, in the minds even of men of science, who have thought mechanics deserving their attention, to be combated.

"To give ships great horizontal expansion, in proportion to their depth, which I conceive essential to the perfection of their form, the construction of their hulls, in other respects, must undergo a change. The bow and the sides are, or rather ought to be, constructed upon principles directly opposite. The one is to break through the water; the other to resist all force that gives the body of the vessel a disposition to leeway. The perfection of the former is, to have as few points of direct resistance as possible; that of the latter, it would seem, to present as many: must it not then, to an unprejudiced observer, appear extraordinary, that both parts should be composed of segments of circles; scarcely a superficial square foot of the largest ship's side, below the water-mark, lying perpendicular to horizontal pressure? The keel, in fact, with some small extent of plane immediately above it, springing from the bottom, are trusted to for resistance; but these are, in most cases, insufficient; few vessels, except frigates, and others of extraordinary length, being found to sail well upon a wind.

"An argument, universally used by seamen and ship-builders, in support of the present construction as to depth, is, that what they technically call 'a gripe of the water below the power of the surge,' is essential in preventing vessels from being driven to leeward. As this argument strikes directly at the root of any improved system founded on expansion, it is necessary that it should not remain unanswered.

"A gripe below the influence of the surge, if it means any thing, implies resistance to the force of waves beating against a ship's side. Now, supposing this resistance possible, the first high sea that should strike her on the beam, in a gale of wind, would inevitably either overset or destroy her, by forcing in her side; the security therefore of ships, in numberless cases that constantly occur, depends on their yielding to the force of waves. Admitting, however, for argument sake, that, in storms, the dexterity of seamen may prevent a ship from being exposed to the violenee of the sea upon her broadside, let us see how, in moderate weather, the deep gripe can operate.

"Waves, I believe, are not thought to run very high, when they rise from six to ten feet above the water level, that is, from twelve to twenty above the trough of the sea; there are few ships whose draught of water exceeds twenty: is it not evident then, that vessels, through all gradations of size, even on their present construction, are in general completely exposed to the power of the surge?

"But, as experiment supersedes arguments, any person in whose mind doubt exists upon this subject, may satisfy himself by viewing a small cutter, when sailing upon a wind, in company with large ships; or, by observing a wherry, which draws still less water, working to windward: nay, even a ship's long-boat, the most flat of all sea vessels *, may serve to convince him, that he may dismiss those doubts, without running much risk of falling into error, and satisfy himself that, provided a vessel have hold of the water proportionate to her size, it is of little moment whether the gripe be near to, or remote from, the surface.

* Excepting the Launch, which is still more so. *Editor.*

" The improvements, then, which I beg leave to recommend in the construction of merchant vessels are, an increase of their horizontal and a decrease of their perpendicular dimensions; which will correct the three defects that I have pointed out: also the alteration in the shape of their sides and bows, which I have already said is necessary, in order to render these improvements practicable.

" Were the length of the keel even so far extended, as that it should reach two perpendicular lines dropped from the extreme points of a ship's upper deck, the increase of gripe would be prodigious, and the additional expence trifling. A sheer or projection abaft is unquestionably beautiful; but it is of no use, and the eye would soon become reconciled to an upright stern. The sheer, however, might be given with any length of keel, where expence should be disregarded; unless it should be thought, which I am rather inclined to believe, that a very long vessel would be weakened by it; for the strain upon a ship's centre is, in fact, resisted more by the binding of her upper planks and timbers, than by the strength of her keel. The expence of this increase of length would be nearly paid by the saving caused by the reduction of her depth.

" The alteration in the form of the sides and bows needs a few words more of explanation.

" The effect to be expected from a flat side, is exemplified in an ingenious contrivance, used to supply want of depth, in Dutch vessels of various descriptions; and I cannot give a more correct idea of the improvement in this respect I wish to recommend, than by saying, that the side of a ship below the water-level, or a part of it, at least, ought to resemble a lee-board, of considerable extent. By means of this board, many Dutch merchant vessels, notwithstanding that they are constructed with a floor almost flat, to fit them for great burden and shallow water, are found to sail tolerably well upon a wind; and yet they are in general short, with bluff upright bows, and many other defects.

" Dutch fishing vessels too, particularly those employed in great numbers on the coast of England, are rendered, by the use of a lee-board, good sailers. Not being intended for burden, they do not, in general, much exceed boat-size; and, although they are the most flat of all decked vessels, their security in blowing weather is proverbial.

" Now, in respect to the bows of merchant ships, I will only observe that, although they slope off tolerably well when vessels are light, they present, when laden, such resistance to head-way, as can scarcely be overcome by any pressure of sail. The evident remedy is, to render them less upright; expansion in them, although absolutely necessary above the water-level, being quite useless below it.

" By adopting these improvements, I am persuaded, that the same quantity of timber, and other materials, now employed in building a merchant vessel of one hundred tons burden, would serve to form one capable of carrying at least one hundred and thirty, and that the velocity gained would rather exceed this proportion. The advantage of performing three voyages in the usual time of two, or even suppose five in the time of four, need not be stated; nor need that which would result, in the season of tempest, from reducing the length of time in which ships are exposed to danger; or in time of war, from rendering them capable of evading pursuit.

" The construction of vessels employed in carrying mails between Dublin and Holyhead, I conceive to be nearly as defective as that of merchant ships, which their hulls in a great measure resemble, although they are built expressly for speed and accommodation, and not for burden. But, indeed, they do carry burden; for, from their deep form, they require an absolute loading of ballast, to prevent them from oversetting; and their draught of water is such, although small vessels, that they can float on the Dublin Bar only at a particular time of tide; by which, fair winds are frequently missed, and the passage from England unnecessarily prolonged. From their want of length, and excessive depth, they are such slow sailers, that the Favourite, a light long vessel, fitted out by private individuals, has made her passage to Holyhead in nine hours, when two packets, which weighed anchor when she did, took twelve to perform theirs.

" In determining the most proper construction for these, or indeed any other sea vessels, it should be considered, that the greater the length, the less depth will be necessary to prevent leeway; and that the greater the breadth, the more sail may be carried, and the less ballast required. Weight, it is true, does not operate exactly upon ships as burden does upon animals; its situation, as I have already said, determining in a great measure the resistance it causes to velocity; but, that its operation is considerable, cannot, I believe, be doubted. In short, I am persuaded, that packet vessels might be constructed on a principle so light, that they might pass the Dublin Bar, at any time of tide, so speedily, that they would commonly perform their voyage in three-fourths, or perhaps two-thirds, of the time those in use now employ; and, at the same time that they would, if possible, be more safe, and certainly much more commodious, their building and sailing charges would not be more considerable.

" To determine the exact extent to which the improvements I recommend can, in general be practically applied, is not my present object. I only mean to suggest hints, which, if thought deserving of the trouble, may easily be thrown into a regular system; and I will close an address, imperceptibly extended beyond its intended limits, with a word on ships of war.

" If these improvements be founded on the true principles of naval architecture, their application may certainly be extended to the construction of frigates, and all other King's ships carrying one tier of guns only; but, that those of two and three tier can be improved in an equal degree, is an assertion I will not hazard. The effect of the weight that the latter carry above water must be counteracted by a proportionate weight below it; and it is possible that an increase of their horizontal expansion would be unsafe, considering that timber beyond the present dimensions cannot be well procured. Determinate flatness of side, however, for some distance below the surface of the water, would aid very considerably in resisting the effect of a side-wind on so prodigious a surface as their hulls present above water; and, even a trifling addition to their breadth of beam *, would probably enable them to carry their guns better than they now do in a high sea, and render some reduction of their draught of water practicable.

" That light frigates might be made capable of receiving as great velocity from a moderate breeze as is now given them by a strong wind, is a truth I am persuaded of; and, that the utmost velocity any vessels are capable of is not yet attained in the European seas, is a fact

* Mr. Snodgrass, late Surveyor to the East India Company, was of the same opinion. See his Observations hereafter: See, also, Midship Sections, Plate 8.

that will not be doubted by any person who credits the well authenticated accounts given of Flying Proas. The form of these vessels, it is true, unfits them for any other sea but that in the latitude of the Ladrone Islands, but useful hints may, notwithstanding, be taken from their construction."

§ 10. REMARKS ON THE FORMATION OF MERCHANT SHIPPING IN PARTICULAR. BY MR. W. HUTCHINSON, LATE DOCK MASTER AT LIVERPOOL*.

1. *Observations on the Form of the Fore and After Bodies or Bows and Buttocks of Ships.*

"IN the curvature of the bows and buttocks of ships, and the effects of them at sea, I have experienced a remarkable difference, from the over-full bowed collier to the over-sharp bowed ship formed like a wedge. Of the latter, I had the experience of one that would not carry a necessary pressure of sail upon a wind in a rough sea, without plunging her sharp bows and forecastle so dangerously deep into the sea, as to fill her main deck, full and full, with water; which not only deadened her headway so as to hinder her sailing, but strained and filled her with water to such a dangerous degree, as to oblige us to shorten sail, and add baling to pumping, in order to save her from sinking.

"The buttocks as well as the bows deserve particular notice; for, if they are built too full in proportion to the bows, at the load-water or sailing mark, they will tow a great deal of eddied, or what is called dead, water after them; which not only hinders both sailing and steering, but, in bad weather, when the waves run high, they lift the stern and plunge the ship's head too much into the waves; particularly when it be necessary to carry a press of sail, and make her ship a great deal of water. If the main transom be too broad, and lies too low, it increases the bad effects in proportion.

"But all defects of this kind are best proved by facts. In the war, 1745, I was in a fine frigate-built ship, for the Leghorn trade, that carried twenty six-pounders on her main deck, and went a cruizing in the Mediterranean; but she, having buttocks too full, did not sail to expectation; and, a very sharp concave entrance below, with a pretty full harpin above, occasioned her to have a very bad jerking, destructive, pitching, motion, when obliged to carry any thing of a pressing sail in a rough sea, that always put our masts in great danger of being pitched away.

"Yet the buttocks, as may be observed, are often built too sharp, at the load mark, in proportion to the bows. This is evident from the many ships that have been built so as to be called 'full bowed and clean tailed ships;' which mode of construction has had great run in practice, and therefore deserves particular notice.

"Full bows and clean tails, as they are called, have been carried to the extreme in construct-

* The valuable treatise from which these remarks are abstracted is comprised in one volume, quarto, and now published by the Proprietor of the present work, P. Steel, London. Price 18s.

ing ships for the coal trade, and in some merchant shipping. But, experience has shewn, that this form has not been attended with the advantages expected from it. For, their over-full bows, especially when laden, always drive a great swell of water before them, which not only impedes sailing, but likewise steering, even in fine weather and smooth water; and, in bad weather, when the waves run high, puts it out of the power of the best helmsman to steer them near their course. At such times, when sailing before the wind, they are very liable to broach to *, and the opposing and floatsome property of their broad bows in proportion to their thin tails, (especially if they have transoms too narrow,) makes them very liable to be pooped; and, in lying-to, plunges their counters and sterns dangerously deep into the sea, and make them in rough weather ride very hard upon their cables at an anchor.

" I experienced the same defects, from the same cause, though in a less degree, in a cod smack which I had built with full bows, a clean tail, and a narrow transom, according to a draught drawn in London. This draught I had afterwards improved, and caused an ingenious builder at Liverpool to build another of the same dimensions, but with somewhat sharper bows, and buttocks of a more middling fullness, suitable to each other, at the water's edge, with a broader transom, which had the desired effect, and gave her the advantage of being both a better sailer, and a better stormy weather vessel, than the other, which cod smacks require to be; for they are obliged to lie-to, to catch their fish, and to beat the sea in all weather possible, to get them alive to market.

This evident improvement upon the clean tailed vessel, and the experience I had afterwards in a privateer, built by the same person, for a common merchant ship, with what I call a middling full bow and buttock, answered the purpose so well in sailing, that the success attending it excited me to present him with a piece of plate, with a suitable motto, '*as a grateful acknowledgement to Robert Brekel, &c.*'

" Other merchant ships built by him and by other builders at Liverpool, on a similar plan, were remarkably successful as cruizers in the year 1778; and, by fair sailing in chase, took several of the enemies sharpest built vessels, which had been constructed for sailing only, with bows and buttocks formed like wedges, which only answer the purpose of sailing fast in fine weather and smooth water, but not in rough winds and waves.

" To the above instances may be added, that, in the year 1746, I was in a middling full built ship, called the Pearl, that was taken by a French squadron of sharp Toulon built ships in light winds; but, afterwards, when it came to blow so strong as to put us under close reefed top-sails upon a wind, our vessel could be the headmost and weathermost ship of their fleet.

" I had afterwards the command of a very extraordinary sharp slight ship, built at Malta, with very small scantlings of timber and plank, long, low, and narrow, being only twenty-seven feet

* For a ship to *Broach-to*, is, to incline suddenly to windward of her course when she sails with a large wind; or, when she sails directly before the wind, to deviate from the line of her course, either to the right or left, with such rapidity as to bring her side unexpectedly to windward, and sails aback, thereby endangering her oversetting. This dangerous evolution is more fully described in the next section.

Vessels, in general, broach to in a sea, from not answering their helm sufficiently quick; perhaps from the force of the sea depriving, by its lift for a time, the rudder of its power. It is often occasioned in deep laden vessels by their being too much loaded by the head; so that, in all weathers, they require a great deal of weather helm; or, as it is termed, *steer wild*.

beam to eighty-eight feet keel, with shelving, shallow, sharp, main body, bow and buttocks, for a cruizing ship, which purpose she answered well in light winds, fine weather, and smooth water. In chasing large, with little wind and a head swell, we have steered right up to the chase, when all their endeavours could not keep their ship's head to the swell, but lay broadside to it. A small pressure of wind and sail would put this shell of a ship to her utmost speed, so that we never desired the wind to blow with greater velocity than about ten miles an hour; when, I reckon a middling stiff ship can just carry top gallant sails upon a wind in smooth water, which gave us the greatest advantages in sailing, compared with other ships, in chase, to take or leave the enemy at pleasure. But in tacking, when it blowed so fresh that we could just carry whole topsails, we were obliged to haul up our courses to make her sure in staying, otherwise she would get such sternway before she brought the wind ahead, as prevented her staying. This bad property I attributed to the lightness and length of her body, in proportion to her breadth, that could not bear so much sail aback in the long time she took to bring the wind ahead.

"This ship frequently fell in with our strong cruizing ships of war, who naturally gave chase to us, and we to them, till we knew them; when, commonly, we made sail, and steering from them, left them in light winds with ease till out of sight. Once, however, in a fresh gale, it happened, that we run before the wind, within about two miles, right to windward of one of our seventy gun ships, which was in chase of us, when we hauled the wind, the sea being smooth, thinking to outsail them as usual; but, as we could only carry close reefed topsails, they out-carried us with sail, and would have brought us to, in spight of our utmost endeavours, if we had continued sailing close by the wind; but the weather gage we had, admitting us to sail a point or two from the wind, gave us the advantage of leaving them by sailing large. We also met with a twenty-gun frigate that was fully a match for us in sailing large in a gale. These particular circumstances are mentioned, in order to invalidate the notion of a ship's sailing faster by being made weaker; for this ship was so weak in bad weather, when the waves ran high, that we could hardly keep her together, and in chasing to windward at such times, she used to plunge her over-sharp bow so deep into the waves, as to oblige us to shorten sail, and add baling to pumping, to save her from sinking; so that, if the chase had known our condition, and kept her wind, she might have escaped: but, bearing away before the wind, gave us the advantage so as to take her; and then we were obliged to run before the wind to a road-stead, to stop our leaks, and to go to the Island of Malta, to get the vessel repaired and strengthened.

"These facts, derived from observation and experience, evidently prove, that there is a medium in the form of the bows and buttocks of ships, which would answer best in all weathers in general; and which certainly ought to be aimed at by some fixed rule, in order to prevent, as much as possible, such important defects as have been described; and, in order to proportion the parts to each other to the greatest advantage for the ship's sailing, not only in fine, but in rough and bad weather; and to be lively and easy in the sea, when the waves run high in a storm; or, when put past carrying a sail, but obliged to lie to, or come to an anchor and ride hard upon a lee-shore, &c. or, having no head way, but, when lying-to, as in common, with the helm a-lee, getting stern way; or, when veering or scudding before the wind in a storm, &c. at which times all ships require to have what I call a middling broad transom, and a moderate spreading buttock, at the load mark abaft, to buoy up and prevent their being pooped; the weakest parts of the ship, the counter and stern, being liable to be stove in by the power of the waves striking against them.

"Upon the whole, it may be concluded, that our fastest sailing vessels are just the reverse of the 'full bowed and clean tailed' ships, and have clean or sharp bows and full tails or buttocks in their water lines, at their best sailing trim. Square tucks, deep in the water, must certainly tow eddied water, and retard sailing much more than circular formed buttocks would do. These extremes, and other important defects, may, doubtless, be avoided in great measure, by fixing on some such as the following rules, to form the water line of the bows, at the harpin forward and the buttocks aft, at the load water mark, by a sweep of a circle of half the three-fourths of the main breadth, which I reckon is sharp enough for merchant ships *. Where there is water enough for sailing, they may always be trimmed from twelve to eighteen inches by the stern: this will not only prevent the bow from being plunged too deep into the sea, when pressed hard with sail, but will elevate the circular buttock, which some object to as being too full, and form a sharper run for the water to quit it abaft.

Of Ships with both Bows and Buttocks too full both for sailing and steering.

"The rule above given, for raking the stem, will admit all the water lines in the ship's entrance to form convex curves, all the way from the stem to the midship or main frame; which will answer much better for sailing, as well as making a ship more easy and lively in bad weather, than those unnatural concave entrances which occasion destructive pitching motions. And the bows should flair off, rounding in a circular form from the bends up to the gunwale; the lower part of the bends at the stem, which I call the lower harpin, to the gunwale, which I call the upper harpin, in order to meet the main breadth the sooner, with a sweep of half the main breadth at the gunwale amidships, which will not only prevent, in great measure, their being plunged under water in bad weather, but spread the standing fore rigging the more to support the masts and sails forward to much greater advantage than in over-sharp bowed ships. And, as the sailing trim of ships in general is more or less by the stern, this makes the water lines of the entrance in proportion the sharper, so as to enable the ship to pass through the water with the least resistance.

"The run ought to be formed shorter or longer, fuller or sharper, in proportion to the entrance and main body, as the ship is designed for burden or fast-sailing. The convex curve of the water lines should lessen gradually from the load or sailing mark aft, downwards, till a fair straight taper is formed from the after part of the floor to the stern-post below, without any concavity in the water lines, which will not only add buoyancy and burden to the after body and run of the ship, but, in my opinion, will help both her sailing and steering motions.

"Some such plain simple rules as these, which nature, reason, and experience, evidently point out to us, ought to have a fair trial in draughting and constructing ships; and to have their good or bad properties compared with our ships of different construction, when they are, as nearly as possible, under the same circumstances in practice: by which means standard rules

* The cycloidal form would perhaps answer here; not only in the horizontal, but, as far as it could be followed, in the vertical, formation of bows and buttocks. A cycloidal arc might answer, particularly, near the load water line, with a proportional strait of breadth along the midships. See the article Cycloid in Chapter I. *(Editor.)*

may be fixed for the best construction of this description of shipping, as there can be but one form that will answer best.

2. *On proportional Dimensions for Merchant Shipping.*

"Ships and vessels which are built too long in proportion to their breadth, are bad to steer, stay, or veer, when required; and, when built too high, in proportion to their breadth, it makes them so crank as to be in danger of oversetting. I judge the latter to be the more dangerous of the two extremes: and, as such vessels require to be set down in the water by an extraordinary weight of ballast, goods, or heavy materials, before they are sufficiently stiff to carry sail; this is a great hindrance to their sailing in general, but especially upon a wind, as it is known by experience that many a fine bottom has been spoiled for sailing fast, by having too great a top upon it. This defect may, probably, have sometimes been owing to that unfair and erroneous method of calculating the tonnage for measurement, by half the breadth for the depth, for payment, instead of the whole depth with which a vessel is built; as the latter practice ought in justice to take place between the builders and owners, to be a check upon those who want unproportional height, in order to gain more stowage and accommodation for people and passengers, &c.

"With regard to the dimensions, &c. After recommending the after part of the stern-post to be upright, which adds some length to the keel more than common, I would recommend the main or midship frame to be a third of the length of the keel, and to be laid seven twelfths of the length of the keel from the after part of the stern post; and the depth of the hollow, from the main or gun-deck to the ceiling, at the midship or main frame, to be six-tenths of the main breadth.

"For instance, suppose a ship to be ninety feet keel, this gives thirty feet beam; the tenth part of that is three feet, and six times three gives eighteen feet, for the depth of the hold, from the main or gun deck a midships, and main frame to the ceiling; and the lower beams of the lower deck may be laid higher or lower as may best answer for strength, stowage, or other advantages, for the trade or other purpose the ship may be designed for. The same rule naturally points out, that the length of the keel should be three times the breadth of the beam, by which the stowage, burden, and value of the ship, is to be calculated *.

"To form the entrance and run of this ship;—twenty-two feet six inches is her breadth at the main transom, three-fourths of her main breadth; and the water line of the bow at the harpin, or lower part of the bends, as well as the buttock at the load mark aft, is to be formed by a sweep of eleven feet three inches, half the length of the main transom, just as far from the stem and stern post as to admit the formation of a regular convex water-line curve to the midship or main frame. And the rake of the stem is to admit the rabbet for the hooding of the bow and entrance to form the same curve from the keel upward, as the water line from the stem at the harpin towards the main breadth. And, from the hoodings at the stem of the entrance, as well as at the stern post in the run, all the water lines should form regular convex curves to

* The best proportions for merchant and other shipping, according to the most recent practice, may be seen in folio I. of the Table of Dimensions and Scantlings hereafter.

the main frame and lowest floorings, which are either long and flat for burden, or raising and sharp for fast sailing; which last must give the advantage, and is absolutely necessary for the slave trade, to shorten the passage by sailing fast when *dangerously crowded* *. And the bows from the lower harpin should flair up to the gunwale to form the bows with a sweep of a circle of half the main breadth at the gunwale amidships."

The intelligent author of the foregoing observations, which have been abstracted from many other of the same description included in his work, exemplified the rules which he thus laid down in the structure of the ship Hall, of Liverpool; a vessel which, it seems, well answered the expectations that were entertained of her superior qualities; and of which Mr. Hutchinson has given an ample detail in his treatise. This detail would, however, be of little utility here; as the mode of construction which we shall explain hereafter, will be found to embrace all the advantages to be derived from the improved state of the art. We therefore now pass on to another division of the subject; namely, a descriptive account of improvements in the construction of vessels, which have arisen from the skill and ingenuity of Captain Schank of the Royal Navy.

§ 11. OF THE PARTICULAR ADVANTAGES OF VESSELS CONSTRUCTED WITH SLIDING KEELS, AND OTHER IMPROVEMENTS, INTRODUCED BY JOHN SCHANK, ESQ. A CAPTAIN IN THE ROYAL NAVY, &C.

The only methods formerly proposed for accelerating the velocity of vessels, and prevent their falling to leeward, &c. were, by diminishing the breadth and adding to the depth and length.

That a body, moving in water, is resisted according to the figure and extent of surface by which it is directly opposed, has been sufficiently explained. But, it is to be observed, that the pressure, and, consequently, the resistance, of fluids, does not depend merely on these particulars; but, more especially, upon the depth immersed in the water. For, the deeper a moving body be immersed the greater resistance will it meet, in proportion to the depth: and, it will be obvious that, in bodies which move horizontally, the weight of water to be removed must be in proportion to the depth.

It follows, that diminishing the draught of water of a vessel must be a more effectual method of accelerating its velocity than proportionally diminishing its breadth, inasmuch as the resistance from the under water exceeds that above it.

If we estimate the pressure on the sides of a vessel, we shall find that, *(cæteris paribus,)* it is three times as great on the lower as on the upper half of that part of it that is immersed; so

* This observation has lost something of its utility, since the infamous traffic and inhuman management here alluded to have been regulated by the statute 39 Geo. III. c. 80.

that a vessel, after having its draught of water diminished one half, will be opposed in moving by one fourth of the former resistance only: whereas, if reduced one half in breadth, and proportionally in weight, it will still meet with half the former resistance (or nearly so), even in moving in the direction of the keel's length*.

But, although diminishing the draught of water is, undoubtedly, the most effectual method of augmenting the velocity with which vessels go before the wind; yet, as it proportionably diminishes their hold in the water, it renders them extremely liable to be driven to leeward, and altogether incapable of keeping a good wind. Hence we require the application of a principle that counteracts this effect; namely, of that principle which affords most resistance to the water in a lateral or side direction, and which is found in a perpendicular flat surface.

These principles are combined in the invention which we are about to describe; and by which those vessels calculated to sail with the greatest velocity are rendered sufficiently weatherly to hold a good wind, and thereby of keeping a direct course, with as little deflection, as vessels built much sharper and considerably deeper.

The "Sliding Keels" are a species of machinery so constructed as to slide down to a certain depth below the bottom of the vessel in which they are fitted, and to be drawn up within it as occasion may require. The invention promises the great desiderata of expedition and safety; and the expectations of its utility have been realized by experience. Whether, however, it be, or be not, quite perfect, we shall not attempt to decide. But, we trust that it will appear, from the following observations, that it furnishes, *at least*, considerable advantages to the smaller classes of vessels over those of the ordinary description.

On the draught of the Cutter, *(Plate XIX.)*, whose original construction has been highly approved, may be seen the plan and mode of fitting the Sliding Keels; together with the midship section of a Cutter constructed so as to be fitted with them. By a comparison of the two, it will be seen, that the latter, with sliding keels, draws full three feet less water than the former; which reduction of depth must consequently add to her velocity, while the sliding keels will prevent her from being leewardly upon a wind †.

In order to give the reader a correct idea of the origin of this useful invention, it becomes necessary to observe, that Captain Schank is a gentleman who, in his professional capacity, during the American war, gave evident proofs of his talent for invention and resource on the Lakes of that Continent. There he obtained the favour and patronage of the present Duke of Northumberland, then Earl Percy, who was on service with his regiment. His Grace had, so long ago as that period, discovered a taste for naval architecture, the knowledge of which he now possesses in an eminent degree: and, in a conversation on the art of Ship-building, betwixt his Grace and Captain Schank, the idea of Sliding Keels first suggested itself to the latter.

His Grace observing, that "if Cutters were built much flatter, so as to go on the surface, "and not draw much water, they would sail faster, and might still be enabled to carry as much

* See, however, the Experiments of M. Buat, p. 114.

† The foremost keel may be farther forward, and the after one farther aft, than as represented on the draught. Because, had our Cutter been constructed for Sliding Keels, her boxing would have been farther forward, and her sternpost need not have raked half so much.

"sail, and keep up to the wind, by having their keels descend to a certain depth; and, that the "*flat side* of the keel, when presented to the water, would even make them able to spread "more canvas, and hold the wind better, than on a construction whereby they present only "the *circular surface* of the body to the water;" Captain Schank coincided in this opinion, and observed, that if this *deep keel was made moveable, and to be screwed upwards into a trunk, or well formed within the vessel,* so as that on necessity they might draw little water, all these advantages might be obtained.

Captain Schank having maturely considered the principle thus suggested, was fully convinced of its use and practicability, and afterwards (viz. in 1774) solicited Lord Percy, then at Boston in New England, to permit him to build a boat for his Lordship upon that construction. He did so, and it was found to answer in every respect. This boat was nearly 27 feet in length and four feet in depth. It was fitted with one sliding keel, more than 20 feet in length, by means of which it was found that the boat could be worked without the rudder.

Captain Schank having afterwards communicated his plans to the Navy Board, in the year 1789, two boats of 13 tons each, were ordered to be built at Deptford; one on the old construction, and the other flat-bottomed, with three sliding keels. Of these, in the year 1790, a comparative trial was made, on the River Thames, in presence of the Commissioners of the Navy. Each boat had the same quantity of sail; and, although the vessel on the old construction had lee-boards, a greater quantity of ballast, and two Thames Pilots on board, yet the vessel with sliding keels beat the other vessel, to the astonishment of all present, one half of the whole distance sailed; and there is little doubt but that her superiority would have appeared still greater, had she been furnished with a pilot.

This experiment gave so much satisfaction, that a King's Cutter, of 120 tons, was almost immediately ordered, by the Lords of the Admiralty, to be built on the same construction; and Captain Schank was requested to superintend its building. This vessel was launched at Plymouth in 1791, and named the Trial. Since that time have been built the Cynthia, sloop of war, and several other vessels; in all of which, it appears, that the sliding keels have fully answered the expectations of the ingenious inventor; but, particularly, in the Lady Nelson, a vessel of only 60 tons burthen, commanded by Lieut. James Grant, and sent on a *voyage of discovery to New South Wales*, in the year 1800, where she arrived safely, without the least damage in hull, masts, sails, or rigging.

Of the Trial Cutter, we are furnished with the following particulars, written in the year 1791. "His Majesty's cutter, the Trial, commanded by Lieut. Malbon, is built on an entire new construction, with three sliding keels, each of which is inclosed in a case or well; one forward, one amidships, and the other abaft: they are all worked with great facility, and are not of the least inconvenience to the crew when manœuvring the vessel.

"The Trial is of 121 tons burthen by admeasurement; pierced for 12 guns, mounts 8 carriage and 4 swivels; length, 65 feet; breadth extreme, 21 feet 4 inches; moulded 20 feet 11 inches; depth in hold, 7 feet 2 inches. Her bottom perfectly flat; draws only 6 feet and a half of water, with all her guns, stores, &c. whereas all others of her tonnage, on the old construction, draw thirteen: so that, by such an easy draught of water, she can go with safety into almost any harbour or creek whatever. In the construction of her, straight timber is chiefly used, by which article alone (without mentioning the many other extraordinary properties belonging to her not possessed by other ships) an immense saving is made of one half of the price of building a vessel of the same tonnage on the old construction. By means of her sliding keels, when at sea, which let down seven feet below her bottom, she is kept perfectly steady in the greatest gale; and, when at anchor, she rides more upright and even than any other ship can do. The keels work as perfectly in a storm as in still water; the vessel does not strain in the least; and never takes in water on her deck. She sails incomparably fast, either before or upon a wind; no vessel she has been in company with, *of equal size*, (even though copper-bottomed, which she is not,) has been able, upon many trials, to beat her in sailing, and yet her sails seem too small.

"Her hold is divided into several compartments all water-tight, and so contrived that should even a plank or two start at sea in different parts of the vessel, she may afterwards be navigated with the greatest security to any part of the world *: besides, if she should be driven on shore in a gale of wind, she does not soon become a wreck; for her keels will all be hove up into their cases, and the ship being flat-bottomed, she cannot easily be overset; and the crew may be easily saved, by her being able to go into such shallow water."

The following Certificate, by the Officers of the Trial, corroborates the truth of these observations.

CERTIFICATE, &c.

"WE, THE OFFICERS OF HIS MAJESTY'S CUTTER, THE TRIAL, do hereby certify, That the said cutter, with three sliding keels, does, from the effect of the keels, tack, wear, steer upon a wind, sail fast, work to windward, and hold a good wind; and that the keels work with ease, and are not attended with any inconvenience to the working of the vessel. And we also certify, that we see no difference in heaving up or down the keels in blowing weather, or in a sea; but that they work equally well in all sorts of weather; and that these keels are, in our opinion, a great improvement, and are also capable of still greater improvement. And we farther certify, that when the vessel rolls deep in a high sea, we do not observe that the keels strain the vessel, the wells, dock, beam, or sides, or are in the least attended with any bad consequences; but, on the contrary, when down, make the vessel much easier, and prevent her rolling so quickly. And we do further testify, that we never were in any vessel of her size and draught of water that

* The illustrious Dr. Benjamin Franklin, in a letter to Alphonsus Le Roy, published in the second volume of the American Philosophical Transactions, noticed a plan for dividing vessels into compartments rendered water-tight, upon a principle similar to that recommended by Captain Schank, in the following words. "While on this topic of sinking, we cannot help recollecting the well-known practice of the Chinese, to divide the hold of a great ship into a number of separate chambers, by partitions tightly caulked, of which you gave a model in your boat upon the Seine; so that if a leak should spring in one of them, the others are not affected by it; and, though the chamber should fill to a level with the sea, it would not be sufficient to sink the vessel. We have not imitated this practice; some little disadvantage it might occasion in the stowage is perhaps one reason, though that I think might be more than compensated by an abatement in the insurance that would be reasonable, and by a higher price taken of passengers, who would rather prefer going in such a vessel. But our seafaring people are brave, despise danger, and reject such precautions of safety;—being cowards only in one sense,—*that of fearing to be afraid.*"

sailed faster, or carried a greater press of sail, or made better weather. And we also testify, that such of the seamen who have sailed in Cutters say, 'that they never were in one so dry, or that made such good weather.' We further certify, that it is our opinion, that, if the four bulkheads in the hold were taken away, and that her masts and sails were in proportion to her tonnage, and that she was coppered, notwithstanding her uncommon strength, she would sail much faster than she now does. And we also certify, that, from the 3d instant to the date hereof, we have never been in company with any vessel (the Alarm custom-house lugger excepted*) that we can with justice say has beat the Trial. We further certify, that we came into Teignmouth in order to satisfy ourselves with respect to the condition of the wells and keels, before we reported them to your Lordships; and, having cleared the hold near them, do not find that they are in the least degree affected, or do leak, or are even damp. And, lastly, we certify, that we have attended strictly to the Instructions given us by Captain Schank, and have found them, with his observations, to prove the utility of the keels, and their effects on the vessel's working and sailing; all of which we hope will meet with their Lordships' approbation.

Micajah Malbon, Lieut. Commander.
William Milne, Master.
William Mallet, Midshipman.
John Wright, Midshipman."

" TRIAL,
" *Teignmouth, Feb.* 21, 1791."

Construction, &c. The Sliding Keels of the Trial were made of three-inch oak planks, bolted together; they were all 14 feet in length; the middle keel six feet in breadth, and the fore and after keels three feet. Each was inclosed in a case or well, and worked by a winch, &c. as represented in the Engraving†.

The bulkheads of the wells are grooved and tongued together, and the joints laid with thin flannel and white lead; the foremost and after ends being inclosed with a large stantion having rabbats to take the bulkheads, as may be seen in the thwartship section and plan of the after keel. In the plan may also be seen the method of tongueing together the main keel and keelson. Some have used iron for the latter purpose, but we would propose good dry fir, for all the tongues, in preference.

The Keels should be put together as shewn on the figure of the foremost keel in the draught; that is, the bolts should not be driven throughout the whole breadth, as by this method the keel would be nearly cut off; but every two pieces should be bolted together as represented, dividing or spacing the bolts so that they may only partially wound the keel. Then copper or iron straps, let in flush, may be bolted across, as shewn on the plate.

* The Alarm being much longer, having more sails, and being copper-bottomed, ought not to be put in comparison.

† In answer to any suspicion that the apertures in the keel must weaken the frame, and the trunks hurt the stowage; it may be observed, that the Cutter, after 18 months constant cruising in the Channel, was found, on a minute inspection in Woolwich Dock-yard, to be perfectly free from any appearance of defect that could possibly arise from being weakened or strained by the sliding keels.

Captain Schank has comprehended the advantages of the Sliding Keels under the six following heads:—1. That vessels thus constructed will sail faster, steer easier, and tack and veer quicker, and in less room: 2. They will carry more, and draw less water: 3. They will ride more easy at an anchor: 4. They will take the ground better: 5. In case of shipwreck, of springing a leak, or of fire, they are more safe and more likely to be saved: 6. and, lastly, that they will answer better as men of war, bombs, fire-ships, floating batteries, gun-boats, gun-batteaux, and flat-bottomed boats for landing troops.

1. With respect to vessels, so constructed, sailing faster, he says, it has ever been his opinion, that a ship's sailing fast does not so much depend upon her being sharply built, as it does on her depth in the water; because, water is the less easy to divide the deeper it is; to ascertain which, figures of different forms may be sunk to greater or less depth. Such experiments have been made by him, and their results have determined his predilection for the sliding keel.—Suppose a frigate drawing 17 feet, and another alike in burthen, drawing eleven; the last has a body of six feet less to divide, opposing only three, two, or one, keel, as may be found necessary to make her hold a good wind; while the other has six feet depressed, or about one third of her real size opposing the water: of course, she has a body to displace and force through, equal to the difference between 11 and 17 feet, and the deeper the stronger. North-country-built vessels, or those in the coal trade, are proofs of this observation. These vessels generally draw about one-third less water than other English vessels; yet, when employed as transports, they are found to sail as fast as any others; and, when going before the wind, in ballast or half loaded, they frequently beat the King's ships. Now, when these vessels come close-hauled on a wind they drop to leeward; but, had they sliding keels, it may be presumed that they would have the advantage of all others. The Dutch take little pains to make their trading vessels sail, yet when these are light they sail fast before the wind, and this by reason of their small draught of water. That nation has likewise other flat vessels; such as pilot-boats, yagers for carrying the first herrings to market, and pleasure-boats, all of which have lee-boards, by the help of which they sail as fast as most other vessels in the northern seas. Vessels with sliding keels will steer better, be safer, and receive many advantages in consequence of steering easy, and with little helm. The use of the sliding keels, in steering, is seen in every action of the ship's movement; by the sliding keel the ship's course is kept in a more direct line, for the easier the ship steers the nearer she goes on a given point, and the ship's hull, as well as the stern-post, rudder, masts, rigging, and sails, are less strained*. In place of two, three, or four, men at the helm, the largest ship may be steered by one. This is a great advantage; for it is not uncommon that vessels steer ill even in fresh breezes or light winds, so as not to be able, when the wind is on their quarter, to carry all their sails, and thereby are necessitated to go one or two knots an hour slower. Through such defect, and with such a wind, they lose in the twenty-four hours as many knots, or double that number. This in the distance, besides what may be lost in lon-

* The Trial cutter, in which the experiment has been made, when brought-to, with all her keels up, will drive to leeward, leaving her wake over the weather beam; but, on the keels being hove down, she proportionably lessens her drift and fore-reaches; nay, if the helm be given, and all the keels hove down, she will, from one knot or two, increase her motion to four or five; and so in proportion, and according to circumstances.

gitude or latitude by an incorrect course. Hereby the loss of the ship might be occasioned; for even with a good observation the error of the longitude cannot be rectified. But, if no observation should happen to be taken, and the steerage be wild, the error may be great, and the ship in danger in making the land. But the worst consequence of a difficulty in steering, is what it is to be feared has too frequently happened, though rarely heard of, and that is, the ship's broaching-to. This, though sometimes the consequence of a wild or careless steerage is, more frequently occasioned by strong gales and tempestuous seas. Thus, for instance, a ship scudding before the wind, or quartering, having little sail set, and that low, such as a reefed fore-sail, when between two seas, is almost becalmed, and therefore loses her way: the next or following sea raises her stern, her bow inclines downwards, the cutwater having a different direction from the intended course, the stern by this is lifted so high that the rudder has little or no power, it being almost out of the water. In this situation, the ship pressed on her lee-bow, by the water having got on the weather quarter and the ship on the top of the sea, she flies with such violence as to bring her head round; and then lying on the broadside, she plunges with the greatest velocity into a high or raging sea, the water breaks into her, washing and carrying away every thing off the deck, frequently some of the crew; and it is to be feared that, by such accidents, vessels themselves go to the bottom, and are no more heard of. Now, there is nothing more clear and certain, than that sliding keels counteract these dreadful effects; for, in a fresh breeze, or light winds, all possible sail may be made without regard to the wind, or on what mast sail is carried. The moment sail is made, and the course shaped, the keels may be raised or lowered, until the ship is found to steer easily, and with little helm, by which means quick progress is made, a straight or direct course, and an easy ship. To prevent the dreadful accident of the vessel's broaching-to, no more need be done than to heave the main and fore keels up, and let down as much as is thought necessary of the after keel; and if enough of it is down, it is impossible that any ship can meet with this accident.

Vessels having three, or only two, sliding keels, must tack quicker and in less room; because the foremost keel and the after one have each an effect on them nearly equal to the rudder. Therefore, when going about, or working to windward in a narrow channel, river, &c. where the vessel has little room, they may venture to stand nearer the shore, being more certain of not missing stays. Thus, for instance, in tacking or going about, it has been experienced that to heave up the after keel and let the fore keel close down, at the same time putting the helm a-lee, will make the vessel come much faster round than if she was without sliding keels. Indeed, in the latter case, the difference is so great, that it is as much as the men can do to work or attend the sails, and in a fresh gale they can scarcely trim them in time. The next advantage from the fore keel is, that being hove up as soon as the ship is right with her head to the wind, it remains ready to prevent what happens to most square-rigged vessels, her falling round off, and thereby losing a great deal of ground, time, and tide: therefore, the instant the sails are full, and the vessel has hauled off, and is falling off more, the fore keel must be hove down, which will stop her; and, with the least headway, she flies to as fast as if coming about; and even must be prevented coming round by again raising the fore keel a little up. Vessels with this construction, wanting to veer, are to heave up the fore keel and heave down the after keel;

and, if it be requisite to veer very quickly, the main keel should be hove up also; vessels will then turn or come round as if upon a pivot, the rudder being used at the same time as in common cases. The reason of this is plain; for the fore and main keels being up, and the after keel down, the latter acts as a rudder, and hinders reaching, the effect of it being not unlike what would be produced by a rope fastened to the stern of a vessel in the tide's way, which, the moment her head is at liberty, would swing round with her stern to the tide. In like manner, a vessel drawing more water aft than forward, when she takes the ground with her keel, turns her head round from the sea or tide.

2. Vessels with sliding keels will carry more freight and draw less water. It is well known to every person conversant in naval architecture, that different constructions of vessels cause a difference in the quantity carried. Vessels sharp fore and aft lose a great deal of stowage, and some of them carry the floor so straight and narrow the whole of their length, that by looking down into their holds the difference is easily discernible by the eye. For this reason it is impossible that a true measurement can be made; so that, notwithstanding all that has been written on the subject by mathematicians of different nations, no method will ever be discovered to ascertain a true measurement of vessels until they shall be built more alike. It has been observed, that some vessels of the same measurement would not take in near the quantity they measured, whilst others took in more than theirs, and, moreover, carried it with ease. But, if vessels sharp built could be brought to hold their measurement, they would not be able to carry it, owing to their sharpness forward, which would cause them to pitch and ship water. This difference is constantly to be observed as proceeding from the vessel's construction. Sharp vessels go down so fast, that by the time they come to their bearings they are full, and frequently not nearly loaded; whereas those of flat and long floors go down slowly; and, having the quantity according to what they measure, have still room for more, and are high out of the water. The improvements, therefore, which remain to be made in ship-building, must be tried on a long and flat floor; and, by improvements herein, there is a promise of every advantage that can be derived from the use of shipping. On the plan of long and flat floors every thing can be obtained, except working to windward; and if sliding keels answer the expectation hoped from them in that respect, the point is gained, and vessels will in general hold more than they can carry; whereas at present the contrary is the case with sharp built vessels.

That vessels thus constructed will draw less water is demonstrable, from the largest vessel in the world to the Indian canoe. The collier, the coal-lighter, corn-barge, bean-cod, all afford proofs that the flatter a vessel is, the less water she draws; because the more space a body covers on the surface of the water the less it will sink in it.

3. Vessels constructed in the manner herein described will be more easy at an anchor, by the same reason that they sail faster, carry more, and draw less water. In proof of this assertion the same instances may be adduced. The North-country shipping, and Dutch fishing-vessels, ride at an anchor when no other vessels can; and this because they have long floors, are full fore and aft, rise and fall easier, that is to say, do not pitch or plunge so violently as sharp-built vessels, but have a rolling motion when at anchor, which greatly lessens their pitching and plunging. In consequence, they do not strain the cables or anchors, or the hull, so much as

vessels built on a sharp construction. It is a great advantage in navigation to be able to ride at anchor safely. Voyages may be undertaken with such security, that durst not be attempted in vessels that do not ride well at anchor. Captain Cook, whose practical knowledge of navigation, and the properties of a vessel, stood, perhaps, inferior to that of very few persons in the world, gave a decided preference to a flat-floored vessel, as being best calculated for a distant and perilous voyage, in consequence of her peculiarly possessing those valuable properties just enumerated.

4. Vessels constructed in this manner will take the ground better, and sit more upright and easy than others. Flat-floored vessels, not having a rank keel, when on the ground, sit so that every part of their bottom, from the forming of the entrance forward to the run abaft, bear equally on it; therefore, unless the ground be as perpendicular as their sides, little danger can be apprehended. If the sand or rock be the length of the ship's bottom, or whatever length it be, if nearly even or flat, so much of the vessel's bottom will rest on the ground, and she will certainly not be strained so much as if only a small part of the middle of the vessel touched; which must be the case with a sharp-built vessel. They who have seen vessels take the ground must have observed, that sharp-built vessels, (in which number may be included the ships of war of all nations, the Dutch excepted) the instant they do so, heel in proportion as the water leaves them. Supposing a frigate in this situation, when the water is gone from her, the gunwale would be little more than the height of a man from the ground, and the ship would lay along so much that no one could walk the deck. Thus situated, the vessel would strain so much, from the weight of her masts, guns, rigging, &c. that she would be ruined, even if she were to get off. But if, on the flowing of the tide, it blows the least wind, so that the necessary assistance cannot be given her in the act of righting, she will be filled with water by the hatchway before it flows high enough to float her. Suppose a flat and a sharp vessel in company, and both running aground in a sea, the flat vessel runs on or sticks fast, in either of which cases she sits upright, but the sharp vessel heels in both. The heel the latter takes exposes her to the sea breaking upon her, and by that means either filling her, or washing the crew off the deck: whereas the vessel which sits upright runs none of these risks, and, unless the bottom is beaten out, the chance of saving crew, ship, and cargo, is greatly in favour of the flat-floored vessel. This is so well known to seamen, that both English and Dutch flat-floored vessels coming into harbours where the ground is even, no matter whether soft or hard, so it be smooth, have run aground in the hardest gales rather than be at the trouble or risk of bringing up: by this means they avoid the danger of breaking their cables and anchors, or running on board other vessels. It is remembered that a fleet of transports, coming into Cork harbour for troops in a hard gale, did so, when a sharp vessel, through mistake, following the example, was nearly lost.

5. In cases of shipwreck, springing a leak, or of fire, vessels thus constructed are safer, and more likely to be saved. The reasons last given explain the advantages such vessels have in case of shipwreck; however, let it be added, that the vessels thus recommended would possess a superior degree of security if built as nearly as can be solid; that is, all the frame of timber put so close as to be caulked in the same manner as the plank on the outside. And, if the plank or ceiling of the inside were equally caulked, the vessel by this means would be much stronger,

and of course would bear more beating on the rocks, sands, &c.: then, if the rocks, &c. occasion a leak, if this leak does not go through, it will be stopped in its progress by the caulking: but, if it does go through, it will more readily be heard, and of course more easily come at to be stopped. If a rock is the cause of the damage, and it goes half-way or two-thirds through, and sticks in the vessel, it becomes a plug for the hole it makes; and, if it drop out, even then it will not occasion a leak. But, if the vessel be divided into many equal rooms, or different holds*, supposing a hole to be so large that all the pumps in the ship, and twenty more, cannot clear away the water that rushes in, it will then only come into that single part or division in which the leak happens to be, and will flow in no longer than till it is raised withinside to the level of the sea without. The vessel would, in this case, be in no more danger than before, nor would the hull be loaded or depressed in the water. The difference of construction prevents a flat vessel from oversetting as soon as a sharp vessel; and her setting upright admits of her crew working and loading, or unloading her, as the circumstances may require. Add to all this, that inestimable advantage which the one vessel has over the other, of drawing so little water. By this the flat vessel is enabled to sail over those very rocks on which the sharp-built one will strike; and admits of the former going into shallow water, where the violence of the sea becomes less and less the nearer she approaches the shore.

The reasons given why vessels built upon this construction stand a better chance of being saved, in case of shipwreck, will in a great measure apply to the circumstance of a ship springing a leak at sea, as the effect and appearance of the one correspond with the other, though proceeding from different causes. In the former case you are supposed to be forced on the shore or rocks by the sea, wind, or tide; but, in the latter, to be in the ocean on your voyage at a great distance from land: your ship springs a leak which seriously alarms you; you see that you cannot pump out the water; your cocks in the bulk heads being turned directly, shew in what part of the ship the leak is; you then try with all your pumps to empty this hold, division, or room; not being able to pump it out, you try to get out of that part of the vessel what is in it, and if you can only see the bottom of the ship you will see the leak, and it must be directly stopt. Whereas, in the present construction of ships, the great inconvenience is, that the water may come from any other part of the ship, and the real situation of the leak remain undiscovered. In the case now put, supposing the worst, and that you cannot stop the leak, then putting into that part or division of the ship such things of your cargo as will not receive damage by the wet, and applying the pumps to the other parts, you proceed on your voyage with very little difference, as if no such accident had happened. It may be further observed, that the more things you put into the damaged part or division of the ship the better, as it will lessen the quantity of water, and the weight of its motion in the rolling of the ship. As ships on this construction will be more solid, it is a great chance if, in case of a shake in a plank or timber, or

* Captain Schank is here alluding to his plan of dividing the hold of vessels by separate bulkheads, sufficiently secured against any communication of water from the one to the other, except by cocks, to be used in case of necessity.

a butt end starting, water will find its way more than a few inches; for every part of the plank, inside and out, being closely joined together and caulked, it is impossible it should, unless the leak or hole be directly through. The same observation may be made on a shot or shots striking the ship betwixt wind and water, or even below the water mark; whereas, according to the present construction of vessels, if a shot only splits or shatters the outside plank, or goes through into the timber or ceiling, it occasions a leak of a more dangerous nature, than if it went through the ship's side or bottom; because, in the one case, the water running in can easily be discovered, and may be stopt from the inside; but, in the other, it may run in at the middle of the ship, and oozing fore or aft amongst the timbers, may make its appearance in quite a different place. As already mentioned, in vessels built on this solid construction, the shot sticking in the ship would make a plug for its own hole; and the same observation will apply to accidents occasioned by rocks, sands, or other violence that ships meet with, by which leaks are generally occasioned; and wherever a leak may happen to be, the new invented method of stopping leaks can be applied with more certainty of success.

Vessels divided according to this plan, having three, four, five, six, or more, holds, catching fire in any one of such divisions, have, in the first instance, the advantage of containing all the water thrown in by pumping, &c. in one hold or division, and can have pipes or leathern hose below the water line to communicate with the three wells. By applying all those to the place on fire, which can be done instantly, no ship can burn below the water line; so that all the water drawn or pumped will be applied to keep the fire from the upper works, rigging, &c.: and by this means the magazine can instantly be drowned, or any part of the ship where combustible matter is, can be filled with water. The crew then have every encouragement to stick by the vessel, and endeavour to extinguish the fire: and, if the vessel be in company of other ships, each ship will come as near as possible to that which is in distress, and send boats, men, and engines to her assistance. Whereas, according to the present construction of vessels, a man seeing a ship on fire, and knowing that ship to have powder on board, will not approach her for fear of her blowing up, and thereby involving his own ship in her fate. This was the case with his Majesty's ship St. George, the surrounding vessels not daring to render her any effectual assistance, from the apprehension of her magazine exploding; whereby, though every exertion was made to save her crew, numbers of them were either burnt, drowned, or blown up.

6, and lastly, That vessels thus constructed will answer as men of war, bombs, fire-ships, floating batteries, gun-boats, gun-batteaux, and flat-bottomed boats for landing troops.

The advantage of the wells in filling the magazine with water has, in some measure, been already explained, yet it may not here be improper to mention, that a convenience of this kind has long been a favourite idea with, and the earnest wish of, the greatest officers of the navy. The ingenious Sir Charles Knowles, and Captain Bentinck, with many others, had this object much at heart, but the opposition they met with, and other views, prevented either of them from accomplishing what they so much wished. Captain Bentinck formed plans, not only for the magazine, but for every store-room in the ship. The great difficulty with him was in placing the cocks; but had sliding keels and these wells * been at that time invented, the speedy and easy conveyance of the water would soon have been seen, and there is no doubt would have been applied as has been herein already proposed. In almost every class of vessels having the magazine either fore or aft, the foremost or after well might be so constructed with it, as in time of action to keep every thing damp.

To the foregoing observations, may be added that, as the situations of many harbours render them very difficult of access, by means of shoals, &c. the approach of ships to towns and forts, which are required to be attacked or bombarded, are thereby often rendered both difficult and dangerous. In expeditions of this kind great impediments have been observed to have arisen from the sharpness of vessels, and their great draught of water. The circumstance of drawing much water prevents them from getting near the object of attack, and often occasions, perhaps, the failure of an expedition, from their being obliged to wait for a full tide, which gives the enemy an opportunity of discovering the design, and taking measures accordingly. With regard to the sharpness of vessels, besides the inconvenience of drawing more water, they are subject likewise to another, from the aukward manner in which they take the ground. For, supposing a sharp-built vessel to get near enough to the object of attack, and to be left in that situation by the tide, she cannot throw her shells, because she will be lying almost on her broadside. Being thus exposed to the fire of the enemy, without ability to return it, it is more than probable that before the tide return she will be taken, or the water flow into her before she rights. But vessels built flat and solid, as on the plan herein before recommended, will not be equally liable to these inconveniences; the circumstance of drawing less water will enable them to come nearer the object of attack, remain there longer, and withdraw easier from it; even should such vessels be left by the tide, they might remain during the ebb, doing their duty equally as if afloat.

All the inconveniences now just before pointed out in the case of vessels sharp-built, and having a great draught of water, apply to fire ships, &c. But some advantages may be enumerated as derivable to fire-ships from sliding-keels, which could be of no use with respect to bombs. Such as when, in certain situations, opportunities occur by placing the keels, and so making sail, that fire-ships may run on a direct point, and do the duty required amongst shipping in a road or harbour, or against a town near the water; and it is to be presumed, that with fire-ships thus constructed, it is practicable not only to set fire (if no boom) to a fleet in a harbour, but at the same time so effectually to destroy the harbour itself as to prevent the ships that should not be burnt from coming out, or any other ships of the line from going in.

Many of the reasons given in the two last cases against sharp-built vessels, and in favour of those on a flat construction with sliding-keels, apply to floating batteries, gun-boats, gun-batteaux, and flat-bottomed boats for landing troops. If a floating battery is to be built, it

* The wells here spoken of are the grooves in which the sliding keels move: and by which they are raised up or lowered down. They may have cocks let into them on either side.

should be constructed suitable to the place and object it is intended for, whether it be to go to sea, or to work up rivers; to run a certain distance before the wind, or be towed by boats to the place where they are to act. In either of these cases a variation in the construction would be required; but the most considerable part of the improvement would be in making separate bulk-heads, which in batteries or boats the more numerous the better. For instance; suppose gun-boats are attacking a vessel or fort, or a great number of flat-bottomed boats landing men, if a large shot strike any one of these boats and go through her, the boat must inevitably sink, to the great alarm of the men in the other boats; but, if these vessels are built with bulk heads, the water only can come into two or three places; and unless the shot goes in below the water line at one end of the boat, she will not sink, nor will the men in the other boats know any more of a shot striking her, than of a man being killed."

Thus much Captain Schank has delivered respecting the advantages resulting to vessels constructed with sliding keels, and applicable to ships in the service of government; the observations which follow apply more particularly to trading vessels, and the general improvement of navigation.

1. Vessels thus constructed will sail better as coasters of all kinds, and for the coal trade. The advantages which coasters will derive from this construction are many. It is certain that great numbers of them are lost owing to their great draught of water; and it is also well known that their passages are frequently much lengthened, by their being obliged, when the wind is contrary, to run to leeward to get a good harbour or roadstead. In such cases, if they drew a few feet less water, they would go into many harbours, which they are now obliged to pass. But the inconvenience does not rest here, for even when they arrive at the intended port, they are, perhaps, often obliged to wait several days for a spring-tide, which, when it comes, a gale of wind probably prevents them from taking advantage of, and getting in: and, often the same time may be lost in getting out of the harbour. Besides loss of time, and consequent expence to the owners. All which would, in a great degree, be prevented, were these vessels of a smaller draught of water. According to the plan herein recommended, vessels of one hundred and twenty to one hundred and forty tons, would not draw, when loaded, above five feet and a half of water at most; and all other vessels in the same proportion. Those who are concerned in shipping, and know what water vessels of such burden at present draw, must see with astonishment the advantage of this construction; which would likewise prove more convenient, as such vessels would not require a pier to lie to, and are capable of being moored in any part of a harbour; and, if the ground admit of it, carts, &c. might come along side, and load or unload them, which would also save a great expence.

2. Vessels built on this construction would answer in canals; where the canal is above four or five feet deep. Let us suppose the Duke of Bridgewater's canals, and all others now made, or to be made in the kingdom, to be equal to the depth of the Scotch canal between Glasgow and Carron, the locks to be from sixty to seventy feet long or more, and from twenty to twenty-six or more wide; in such a case, all the trade from any part of the inland country adjoining to the canals could load at any public place, town or village, where a manufactory was carried on; and proceed to the most distant parts of the known world without the assistance of any other

craft. This idea is submitted to the consideration of all those who are concerned in such public undertakings.

3. Vessels thus constructed would be exceedingly convenient to carry corn or mixed cargoes, part of which it is required to keep separate. This is certainly a great convenience when it can be obtained without lessening the tonnage, and bulk heads will serve to separate the cargo, let it be as opposite as iron and gun-powder. The bulk heads answer as separate apartments, or like shifting boards, either for corn, salt, &c. There is, perhaps, nothing, except masts which such a vessel will not answer for, better than any other.

4. Vessels built with sliding-keels have the advantage of all others in case of losing the rudder. Although what has been said respecting the effect of the fore and after keel, and the main or middle keel, are sufficient to prove that vessels with three sliding keels can, in case of losing the rudder, be instantly steered with the keels either on a tack, or working to windward; yet, as experiments have been made, and the efficacy of the keels sufficiently ascertained, it will be necessary to refer to the certificate made by Lieutenant Malbon of the Trial cutter and his officers, to the Lords of the Admiralty; in addition to which, says Captain Schank, I can offer the testimony of the ingenious James Temple, Esq. of Stove, in the County of Devon, who sailed several leagues in the same vessel, only using the keels. "I myself, (he further adds) on many occasions, in the presence of sea-officers of different ranks, steered and worked that vessel in every manner possible, with the keels only: but a still more flattering and more honourable proof remains, as this experiment was made in presence of his Majesty at Weymouth, who was pleased to condescend so far as to examine the construction of the cutter, and to order her to sail in company with him, when signals were settled, by which she was to steer and work to windward, with the keels only; which was done, and his Majesty signified his most gracious approbation."

5. Vessels on this construction will last longer than those built according to the present mode. Long experience has discovered that nothing destroys timber so much as being sometimes wet, at other times dry; sometimes being exposed to the air, and at other times air excluded from it. This is not the case with ships built according to the construction which has been herein often, but it is hoped not inconsiderately, recommended. It is generally known that the bottom of a ship seldom rots in less than fifty or sixty years; and some even last longer, though the upper works decay much sooner. This may be imputed to the distance the timbers are from each other, or to the circumstance of the ceiling not being caulked, which defects admit of a quick succession of different sorts of air, heat and cold, wetness and dryness: but, according to the plan of making the ship more solid, these would, in a great measure, be excluded, and ships would last at least one third longer, if not double the time, they do at present *.

* For farther particulars of the advantages of Captain Schank's Improvements, together with copies of certificates, &c. See Lieutenant Grant's interesting "Narrative of a Voyage of Discovery, performed in his Majesty's vessel the Lady Nelson, of 60 tons burden, with sliding keels, in the years 1800, 1801, and 1802, to New South Wales." This volume contains, among other Engravings, a large draught of the Trial Cutter, and other vessels fitted with the sliding keels, shewing the mode of construction, &c.

2. PROPOSED IMPROVEMENT ON CAPTAIN SCHANK'S PLAN OF FITTING SLIDING KEELS.

An eminent ship builder on the River Thames, by frequently revolving in his mind the invention of the sliding keels, as fitted on board the Trial Cutter, conceived that a considerable improvement of them might be made; the description of which we will lay before our readers in his own words. "It is generally known, that the principal utility of these sliding keels is, in preventing vessels falling off to leeward, when working to windward: which intention they no doubt answer as much as can be expected from them in their present state. What I have now to advance, as an improvement in them is, to alter their direction from the plane of the keel, occasionally, that they may not only prevent the vessel from falling to leeward, but have another superior power of *forcing her up to windward.*

"For which purpose, I shall propose, in the construction of the vessel, (suppose about the size of the Trial,) that she have a flat body, to take the ground well, and stow a large cargo; that the keel be four inches and a half thick, from the fore part of the foremost to the aftpart of the after well; but, thence forward, and thence aft, to increase to a proper depth, to admit of the boxing of the stem, and tenanting of the stern-post; which may easily be done by gradually raising the rabbet for the garboard strake, which in midships would be two inches above the lower part of the keel; and, to prevent the keel rubbing away, on each side, to fasten a thin iron plate with nails along the midship part. *(See the Draught.)*

"From the forepart of the foremost to the aft part of the after well, the keel to be two feet two inches broad; and thence forward, and thence aft, to diminish to the proper siding of the stem and stern post. In the inside to have two keelsons, three feet from each other, equally distant from the middle line; and, to extend so from the fore part of the foremost to the aft part of the after well; and thence forward, and thence aft, gradually to close towards each other, till they meet, and scarph together forming one keelson. The heels of the lower futtocks I should not require so long as is common, but propose to have chocks to go across the keel and scarph to the heels of the lower futtocks, on each side under the keelsons; to bolt the keelsons through every floor timber, and through the chocks and heels of every lower futtock into the garboard strake; and for the keel to be fastened by two small bolts, through every floor timber, each about eight inches from its middle line; and one through every cross chock at its middle line; for the steps of the masts to go across from keelson to keelson, and bolt through them; and to fill up with iron ballast all the vacant room that is aft between the keelsons; which ballast lying so low, will increase the stability of the vessel, and the keelsons will prevent its shifting.

"I never yet heard any satisfactory reason given, why the midship sliding keel should be twice as wide as the others; and, as I think it tends to weaken the vessel where she requires the greatest strength, for that reason (and for another which I shall mention hereafter) I rather approve of each being four feet six inches wide. There will be no deviation required from the usual method of building every other part of the vessel.

Being so securely fastened below, in the manner described, she will be sufficiently strong, after the mortices are cut for the sliding keels, through the main keel, which I propose to be done in the following manner : (*See foremost keel on the half breadth plan, Plate* 19.)

" Let A B be the middle, C D and E F the breadth of the keel (two feet two inches), G the after end of one of the mortices, and H the fore end ; the width of the mortice at the fore end H is twenty inches, at the after end G it is eighteen inches, and at the centre I (which is two feet six inches from the fore end H, and but two feet from the after end G) it is three inches, that being rather more than the thickness of the sliding keel. The wells to be built up in the same form, observing that there be a strong stantion fitted up on each side of the angles I I: The sliding keels which, when quite down, may be I will say six feet below the main keel, to be hung thus; to fix gudgeons to the stantion on the starboard angle I, one about the upper part of the main keel, another six feet above that, and a third, six feet above the second; which last will be nearly as high as the upper deck. On the starboard side of the sliding keel, to fix three long irons of six feet each, to work in these gudgeons; the upper end of one, six feet above the lower end of the sliding keel; another six feet above that, and a third as much above that; these will admit the sliding keel to go down six feet. That a groove be cut from the top to the bottom of the larboard stantion (at the angle I,) to bring a small rope or chain, which is to be fastened to the larboard side of the sliding keel, about five or six feet from its lower end, and lead up in this groove to a winch on the deck, to be fixed there, for the purpose of heaving it up, or lowering it down. Having thus far explained the manner in which I propose to have the vessel built, the wells formed, and the sliding keels hung, I beg leave to enlarge a little on the advantages which it appears to me a vessel will derive from them in going to windward.

" The sliding keels, as they are now fixed on board the Trial (from the description I have ever had) are let down through mortices of a parallel width; equal to the thickness of the sliding keel, and parallel to the middle line of the keel, consequently when down, cannot deviate from that direction.

" In the manner I propose, when they are lowered down, they will form a plane diagonally to that of the keel; which I will describe. (See the foremost keel in the Draught.) Suppose W the windward, and L the lee side, and the light part the sliding keel, in the mortice; AB the middle line of the keel, and B the forward; then, as the vessel moves a head, the water strikes against the lee side of the sliding keel, in a certain direction, the impulse of which will force the vessel up to windward.

" It is true, they will prevent the vessel from going through the water so fast, as if they were in a parallel line with the main keel; but we should consider likewise, that this very impediment forces the vessel to windward in a much greater degree; and, as the water strikes against them obliquely, the resistance is not so considerable: and the impulse of the wind will act with greater power on the sails, in forcing the vessel a head by her not yielding to it in falling to leeward.

" The faster a vessel moves through the water, the more the keels in this diagonal direction will force her to windward; I propose, therefore, that she should be kept a point, or a point and a half more free than is necessary; and, I think, she would then be forced up considerably to windward of her course. The keels being all of one width, will form the same angles to the plane of the keel; which they could not do were they of different widths; and I think it would be as well to have the midship one as near the centre of gravity, and the fore and after ones as nearly at equal distances from it, as possibly can be, for the masts; so that, when they are all down, they may affect the steering of the vessel as little as possible; but that could always be rectified, by heaving up the foremost or aftermost one a little, as may be required: the keels being below the body of the vessel, the direction of the water to the rudder will never be altered by it; nor the rudder lose any of its power in steering the vessel, provided they so regulate the keels, when she is upon her course, that a small helm may then keep her steady. There is only one time in which these keels will not answer every purpose of the rudder, and that is, when sailing in shoal water they cannot be lowered. And, at the time when the action of the rudder is most wanted, these keels will be of great service; no danger of a vessel ever missing stays; put the helm a lee, half down only, and heave up the after keel, the vessel will come round instantly. In tacking about, these keels will ever manage themselves without any assistance; for the centres upon which they traverse, being two feet six inches from the fore, and but two feet from the after end of the mortices, there are of course six inches more surface before the centre than abaft it, for the water to act against, consequently the very pressure of the water, by the vessel's forcing to leeward, will always keep the fore end to windward; and yet at times, if ever it might be necessary, they might easily be put over the contrary way, by means of a tiller, with a score cut through the end, the width of the thickness of the keel, to fit to any part of it that may be most convenient to put it to; it will require but little strength to put them over, there being only the resistance of six inches surface.

"Nor will these keels, in this diagonal direction when let down, injure the stability of vessels, so much as those in a plane with the keel; but there will be a quantity of water in these wells more; they being wider at the two ends; and some of this water when the vessel inclines, will, by lying to leeward, injure the stability, but not much, as the weight is principally below the centre of gravity.

"Should a vessel in an engagement, or by a gale of wind, lose either of her masts, and be obliged in the first instance to make the best of her way, or in the second to make for the first port; let them crowd what canvas they can upon the other two, and should the centre of the pressure of the wind upon the sails be either before or abaft the centre of gravity, it can always be counteracted by means of these keels, and the vessel rendered governable by her helm.

"Or, should a vessel at sea unfortunately lose her rudder, an excellent substitute can be made of these keels, which will answer every purpose of it that I am acquainted with; and should there be any instances in which they would not, the co-operation of the sails I do imagine would be sufficient, without any rudder whatever *."

* Collection of Papers on Naval Architecture, Vol. II. page 26.

§ 12. Remarks on the different classes of British shipping, &c. especially on those of which the draughts or particulars are given in this work.

The various classes of shipping which compose the naval force of Britain, as well as of those which are employed in carrying on the commerce of the country and its intercourse with foreign states, are too well known and defined to need description; we shall, therefore, in this place, confine ourselves merely to a few observations on such peculiar qualities of each as are not so generally known: the latter, only, being interesting to the artist.

The gradually improving state of our shipping within the last fifty years, especially in the merchant service, seems to have kept pace with the regular advancement of every other branch of mechanical science. For, prior to that period, even our first rate ships, now almost equal in perfection to those of any other rate, were then extremely defective; and their defects existed so long after others had improved, that the captains appointed to them reluctantly assumed their command. For, at those times, the general want of stability, in ships of this rate, rendered the charge not merely unwelcome, but frequently dangerous; and their efficient force, owing to the uncertainty of being able to open the lower deck ports, when in presence of an enemy, was too often found inadequate to their magnitude and the number of guns which they carried. These disadvantages have been gradually obviated, since the usual causes of instability have been discovered, the dimensions enlarged, and the practical management familiarized; and they are now, in general, especially those that have most stability, admirable ships in every respect; as they sail well, and combine almost every good quality. Large as they are, they are perfectly manageable; and their evolutions are generally made with wonderful facility.

Our Second Rates, or, rather, our ships of ninety guns, have, too generally, those defects in their construction which contribute to instability: arising from want of that capacity which most of the first rates possess; and, having it, have the chief corrective against instability in three-decked ships, wherein the centre of gravity is necessarily very high, and their form the least calculated to derive lateral support from the effort of the water.

We take this opportunity of observing, not only as our own opinion, but as the opinion of many competent judges, that the classes between that of one hundred guns and the eighty gun ship of two decks, are very unnecessarily continued in the British Navy.

Eighty-gun Ships were formerly constructed so as to carry their guns upon three decks; and they were found, in consequence, more disproportionate in their parts, and less useful, than any other large ships in the service. Their topsides were so high above the water, to admit of having three tiers of guns, as to be out of all proportion for the length and breadth; nor could the lower ports be fixed at a sufficient height above water to admit of their being opened in blowing weather, even if not very rough; we admit that the heights between decks and depth in the waist could not be much less than those of a ship of 100 or 90 guns, but must still observe, that they could not be duly proportioned in the water; that is, could not be brought down to that depth which would be found the best sailing trim, if properly constructed.

Ships of this description must therefore labour under many disadvantages, arising from their disproportionate height, even if their principal dimensions were similar in every other respect to those of ships in general. It were useless to enumerate all these disadvantages, because the defects which we have described are generally known and acknowledged. That eighty-gun ships of this class will be continued in the navy is not probable; and we have, therefore, no farther occasion to notice them in our work.

The ship of eighty-guns upon two decks is, on the contrary and altogether, the most useful and valuable one in the service; as such, we have given all the proportions, dimensions, and plans, of this ship; and have selected it, in preference to all others, for the exemplification of the rules of construction: this, with the enlarged seventy-four, being deservedly esteemed as the most perfect in the navy; and as possessing, to an eminent degree, all the properties of capacity, stability, and swiftness. The one of which the particulars will be found hereafter, together with other ships of the line, may be considered, with each of them, as the first of its class, from its great length and superior capacity.

As two-decked ships, inferior to the seventy-four, are often required for expeditions and convoys during war, and as flag ships on foreign stations during peace, the sixty-four gun ship has sometimes been used for these purposes. This ship has also frequently taken her place in line of battle. In the latter case her force has, however, been frequently found incompetent; the seventy-four, of which the French line is chiefly composed, being incomparably superior; and, in the former cases, the fifty-gun ship would equally answer, and at a still less expence. The latter is a very useful ship, although defective in its proportions; for, as its guns are carried upon two decks, the height and breadth are too great in proportion to the length. We have had, notwithstanding, several favourite ships of this class.

The Sixty-four gun ship may be considered, in relation to the seventy-four, as the ninety to the first rate; possessing the same defects, without compensatory qualities; and its continuance is, by no means, desirable in the navy. This is a truth acknowledged by the practice of our adversaries, as sixty-fours have, for some time past, been disused in the French service.

Forty-four gun ships, constructed to carry their guns upon two decks, are as disproportionate in their parts as any other ships in the service. Being exactly on the same principle as the eighty-gun ship of three decks, the observations upon that apply directly to this. Nor is it generally used as a fighting ship. We may therefore also reject this as unworthy of farther notice.

Directly the reverse of this is the frigate constructed to carry forty-four guns upon one deck; the most powerful and most valuable of our frigates. That of which we now speak, rated as of forty-guns, may be so constructed as to have all the qualities which can possibly be united in one ship; for, having but one deck, the height may be in due proportion to the length; and, in consequence thereof, there will be required no more than a proportionable breadth, by which she may be brought down in the water to that depth which is allowed to be the best sailing trim for ships in general. Here then is no obstacle to prevent her being duly qualified in point of velocity. Her dimensions, also, being greater than those of the forty-four with two decks, enables her to carry heavier metal, which must, consequently, render her a formidable ship.

Hence it is, that this frigate may be ranked as the most valuable frigate of the English navy; and, as such, we give, in Plate IX, a draught of one of the most approved of the class.

The frigates of thirty-eight and thirty-six guns are very little inferior in point of proportion and utility to the forty-four (rated as forty). As their force is less, they consequently require a smaller number of men, a less quantity of provisions, and are more readily equipped.

The frigates of thirty-two guns are well proportioned; and, of course, equally estimable and useful. In short, our frigates, in general, are excellent cruizers; they sail well, and are remarkable for stability. Those from thirty-six to forty-four guns upon one deck are, indeed, admirable: and the whole, together with the sloop of war, of which we present a draught and dimensions, are highly eminent for their superior qualities.

The *Tribune*, a frigate of 36 guns, lately built in a merchant-yard, by the express order of the Right Honourable Earl St. Vincent, from the draught of the Inconstant, has been found, upon trial, to be one of the finest frigates in the navy. Her stability is great, and her sailing qualities admirable. The testimonials of her superiority have induced us to introduce her dimensions in the work, with the variation only of a four-inch bottom, instead of a three-inch bottom, as built: the latter being certainly preferable for so large a ship.

The Sloop, of which both draught and dimensions are given *(see Plate X.)*, has been copied, very nearly, from the draught and dimensions of some sloops built a few years ago, and found to be excellent sea boats. Indeed, one of them, the *Merlin*, rode out a gale or hurricane in the West Indies, when every other vessel was forced from its anchors, and most of them wrecked. As a proof of their superiority, several have been lately built from the same draught.

Of the Dart and Arrow, sloops of war, it becomes necessary to give a particular description, as the nature of their construction is not generally known. The shape of these vessels differs materially from, and is considerably sharper than, that of sloops or other vessels of war in general, as may be seen by the draught, (Plate XI.) and they project or rake forward above the water like a wherry. Their breadth also increases from the water-line upwards, whereby they are stiffer, less likely to overset, and pitch remarkably easy in a sea, whether under sail or at anchor.

They have, generally speaking, been found to sail remarkably well; but, in a head sea and tempestuous weather, their superiority as sea boats has been most decided.

The mode of structure, for the purpose of strength, in these vessels is very different from that in others. The decks are straight fore and aft, the beams are secured to the side in something like the manner lately practised by the French*; but the principal strength seems to depend on the thwartship braces and bulk heads, which connect the sides together in a manner

* That is, by thick waterways and planks of the deck next to them, scored down upon the beams, and bolted through the sides.

more conformable to the practice of civil architecture. The idea of such bulk heads may probably have originated with the Chinese, or with the ancients. *(See Midship Section on the Draught.)*

The outside plank of the bottom is thicker than usual, particularly near the keel and at the gun deck; and, though it is chiefly of oak, yet some of that part which is always under water is of beech or elm. The upper works are chiefly of fir.

Treenails are made more use of than in any other vessels; particularly for the fastening of the deck, instead of iron spike-nails. The shape of the treenails is improved so as to make them hold the plank to the timbers much more securely, though the timbers are, at the same time, less wounded than usual. But, the principal advantage to be expected from this mode of structure is the obviating the necessity of the supply of any particular sort of timber for naval architecture.

The frames or ribs are of oak, but farther asunder, of smaller scantling, and of less curvature, than usual; whereby there is a saving of one-third of the quantity used for this purpose in other vessels. There are no knees, no carlings or ledges, and very little inside planking; so that, according to this mode of construction, ships of any size may be built of such timber as grows straightly, of which there is still a great abundance in this country, together with what is imported for other purposes; besides, that the oak employed is of so reduced a scantling that the cultivation of it, if used in this manner, must promise to afford an adequate profit to the landholder.

It has been estimated that vessels constructed on these principles would cost one-third less than the usual price, although, from their timber being of younger growth, which can be sooner seasoned, and from the mode of connection of the parts, there seems reason to expect that they will be remarkably durable.

The Arrow and Dart have hawse holes in the stern, similar to those in the bows, by which means, in a narrow channel, they may be brought to anchor, and ride stern foremost.

The rudders of these vessels are also of peculiar construction, and work with wheels and pinions (instead of tiller sweep and tiller ropes) by which means their steering is performed with greater ease and certainty in all weathers.

The capstan is formed so that no surging of the messenger is required as with other capstans.

The magazines in these ships are also divided by partitions of tinned copper, so that water may be let in to secure the powder from explosion without wetting of it.

The Dart and Arrow are fitted with eight tanks, on each side, which fill up the angular space under the orlop beams; by which means, near forty tons of water are carried in a space which in casks would not contain half so much. These tanks are lined with tinned copper, of Mr. Wyatt's manufacturing, whereby the water has been found to remain as sweet and clear during two years as it was when first put on board.

The guns of these vessels are mounted on the non-recoil principle; so that they have no recoil but what is afforded by the elasticity of the breechings, on which there seems to be less strain than usual; their connection with the ship's side does not depend on any iron work. The pitching, or rolling in a sea, will never prevent the firing of guns so fitted, and half the number of men are sufficient to fire these guns twice as fast as when fitted in the usual way in other vessels.

The Dart is rigged in the usual manner, with the mast and sails of a sloop of three hundred tons.

In the Arrow, the main mast is in the middle of the ship, and the yards are much more square than usual, so as to spread a greater proportion of sail on this one mast in going afore the wind. The topmasts are shorter and smaller; but, to the main mast, there is an additional topmast, by which the topgallant mast becomes a royal mast: the topmasts are all alike, so as to serve as substitutes one for the other; and, upon the same principle of economy, many of the sails will serve one for the other. The tops are adapted so as to give better support to the topmasts, on a similar plan with those of the Pomone and Stag frigates, which, although they have been almost continually cruizing, have never sprung a topmast since they have been fitted with such tops.

We are indebted for these improvements to the genius of our own country; the whole having been introduced by Samuel Bentham, Esq. Inspector General of his Majesty's Naval Works; from whose plans, upon similar principles, the following schooners, carrying sixteen guns, were also constructed between the years 1796 and 1798.

	Length of Gun-deck. Ft. In.	Length of Keel. Ft. In.	Extreme Breadth. Ft. In.	Depth in Hold. Ft. In.	Draught of Water. Ft. In.
NETLEY	86. 6	71. 0	21. 8	11. 2	9. 3
MILBROOK	82. 6	67. 6	21. 6	9. 8	
REDBRIDGE, ELING	80. 6	64. 6	21. 6	11. 3	11. 0

These vessels have, generally speaking, been found to sail remarkably well; but, in a head sea and tempestuous weather their superiority as sea boats have been most decided. The Eling, and particularly the Netley, which was the last built, are said to have always shewn a remarkable superiority in working to windward in blowing weather.

We now turn to another class equally worthy of commendation: namely, the NEW BRIGS of war, built from the Navy Board Draughts in the year 1804, of which copies may be seen in plates XII, XIII, and XIV, of this work. An inspection of these will be sufficient to give the reader an idea of the superior qualities of this vessel. He will perceive, from the general contour, or figure, that she is admirably adapted for a good sea boat, as well as a good sailer; that her upper works are light, and all unnecessary top-hamper avoided. Having a snug stern, and, apparently, every good quality that can be expected in a vessel of this description. The lower deck, as shewn on the plan, is so fitted with scuttles, that the contents of the hold may be shifted with much less trouble than usual. The other fittings up are equally praise worthy; being peculiarly adapted to the comfort of every officer and every seaman on board.

One of these vessels, the Raven, upon being fitted for sea, at Woolwich, under the directions of her very ingenious and active commander, Captain William Layman, had, agreeably to his recommendation and wishes, among other alterations, the two foremost ports closed up, and the guns taken away. In lieu of which was fitted amidships, immediately before the foremast, a sixty-eight pounder carronade upon a fixed traverse carriage, so as to fire in almost every direction clear of the gunwale, upon the plan shewn in plates 13 and 14; and, in lieu of the two stern chasers, a carronade of the same power, upon an inclined plane abaft. The wonderful accession of force derived from these alterations, and the great advantages to be derived from them in chase, in clearing any enemy's coast, &c. are too obvious to need a comment.

The Royal Yachts, of the *later construction*, form the next class which presents itself to our notice. These, as may be expected from the purposes for which they are designed, are the most beautiful of all vessels which navigate the ocean: nor are their superb embellishments and stately apartments their highest excellencies. They are models, in which may be seen a combination of the best principles of the art. The yacht built for the Prince Royal of Denmark, of which we present both the draught and dimensions, has been found, both for sailing and working, so excellent a vessel, that, it is supposed, she had not a superior in these respects. Her fame has, however, suffered, in some measure, by the greater superiority of the "Royal Sovereign," launched for the particular service of his Majesty in the year 1804; a ship whose exterior and interior are of incomparable beauty; but, whose ornaments, splendid as they are, will scarcely be considered by the artist as more than adequate to the beauties of her form, and her qualities as an excellent sailer and a good sea boat; in which respects she has been found superior to all her predecessors, and the most perfect vessel of her class ever constructed *.

Of Merchant Shipping, in general, being scarcely definable into distinct classes, we cannot speak with that degree of precision as of those of the Royal Navy; because their respective forms and dimensions are dependant, almost entirely, on the local practice or ideas of their respective constructors, and fluctuate accordingly. Those, however, of which we have given either the draughts or particulars, or both, are such as have been actually built, and found upon trial to answer every quality expected from them: the originals, from which our copies have been taken, were therefore considered by their respective possessors as invaluable.

The decks of the 1200 ton East India Ship *(Plate 20)*, are so constructed for height, as to

* Upon one fine morning, when his Majesty was on board, in the summer of 1804, the *Royal Sovereign* quitted Weymouth Roads, and proceeded on a cruize, accompanied by the Royal Charlotte, yacht, (built in the year 1749) the Princess Augusta, yacht, (built in the year 1710) and a frigate. The new yacht excelled her companions so much, in point of sailing, as to drop anchor in the Roads, upon her return, at six in the evening; while the Royal Charlotte did not arrive until ten o'clock at night, the frigate until midnight, and the Princess Augusta until six the next morning: an unquestionable proof of the very great superiority of the Royal Sovereign; of a superiority which gives her the eminent distinction of being, beyond controversy, the *best sailer of the British Navy.*

admit another tier of tea or china more than any other ship of her class; and the ship built from the draught is reckoned as fine a one as any in the trade.

The ship of 544 tons, *(Plate 21,)* has likewise been found to answer exceedingly well; and she is well adapted either for the East or West India trade.

That of 330 tons, of which the dimensions are given, is peculiarly adapted for the West India trade; and has been found to answer so well that several ships have been built from the draught.

The Virginian, Bermudian, and other smaller vessels, of that description, have all been selected from such whose delicacy of form under water was found to give them the excellencies required in vessels adapted for fast sailing. They are recommended, upon the honour of the authors, as vessels that have actually been built, and that have proved the truth of these assertions beyond dispute.

The Berwick Smack, the London Trader of 60 tons, and the Southampton Fishing Hoy, have been deservedly admired. The latter is famous as an excellent little sea boat and a good sailer.

Our merchant vessels have, in general, great stability, arising from their construction; and are, in this respect, equal to any vessels in the universe. It is, however, not to be expected that they should sail, in all directions, equal to the generality of ships of war. Yet, with the wind large, especially when blowing hard, their rate of sailing has frequently been found equal to the latter; although, upon a wind, their inferiority may be very considerable.

We shall now conclude this section, with a brief description of the different boats of which draughts are contained in plates 30 and 31; including a particular description of the new Life Boat, as constructed by Mr. Greathead, of South Shields.

BOATS are mostly open, though the larger sorts may be decked occasionally. They are variously named, and differently constructed according to the purposes for which they are designed. Thus the Long Boat, which is the largest boat that a ship takes with her to sea, is a strongly built burthensome boat, constructed either for rowing or sailing, and variously used for carrying stores, weighing small anchors, or for the conveyance of large parties of the ship's company, &c.

The Launch is a sort of Long Boat, and now most frequently taken to sea in lieu thereof. It is constructed very differently from the Long Boat, particularly abaft, and is proportionably stronger, longer, more flat in its bottom, and lower than that boat; consequently, less fit for sailing, but better calculated for rowing and approaching a flat shore. Its principal superiority to the Long Boat consists, however, in being, by its construction, much more fit to weigh an anchor, or under-run the cable, &c.

The Barge is the next boat with respect to size, but it differs from the Launch exceedingly in its construction. It is much lighter, and considerably narrower in proportion to its length. The Barge is constructed for rowing or sailing, with a handsome body under water, so as easily to divide the fluid, the quality of swiftness being essential to its general purposes, the conveyance of officers of rank to and from the ship.

The Pinnace is, as we have already observed *, a smaller sort of Barge, similar in its figure, and more generally used. Pinnaces never row more than eight oars, whereas Barges are constructed to row with ten, and sometimes with twelve, oars.

Ships' Cutters are very differently constructed from any of the above; as they are shorter, broader, and deeper, in proportion. They are much lighter, are clincher built, and constructed for sailing or rowing.

The Yawl is less than the Pinnace, nearly of the same form, used for the same purposes, and generally rowed with six oars.

The boats above mentioned are those which more particularly belong to ships of war; as merchant ships seldom have more than two; namely, a Long Boat and a Yawl. If they have a third, it is commonly a boat particularly calculated for the countries or places to which they trade, and varies in its construction accordingly. For instance, the boats of Greenland ships, or others employed in the Whale Fishery, which are on a construction peculiarly calculated for that trade, as appears by the draught of the Whale Boat on plate 31. This boat has its two ends alike; it consequently rows either way, and with great velocity.

The Gig, or swift rowing boat, of which the draught is given on plate 31, is longer and narrower in proportion than any of the former. It is very slightly built, and rows exceedingly swift. They are much used about Deal and Dover; and, being excellent sea boats, not unfrequently stretch over to the French coast.

Wherries are small light boats, clincher built, and too well known to need description. They are mostly used in the River Thames for the conveyance of passengers, &c. That of which a draught is given is a superior boat of this class, and such as belongs to a Royal Dock Yard, for the use of the officers.

The LIFE BOAT. The honour of inventing a boat, for the preservation of lives, from ships driven by tempest into the most perilous situations, where winds and waves at once combine to threaten inevitable destruction, was reserved for the ingenious Mr. Henry Greathead, of South Shields; a name which will ever be dear to humanity.

This invaluable boat, of which a draught and section may be seen in plate 31, is, from its admirable form and mode of buoyancy, entitled to the highest praise; as it is almost impossible, even in the most boisterous weather and the highest seas, for it to upset or sink. On the contrary, she rises proudly over every swell, and seems to defy the contending elements.

In the twentieth volume of the Transactions of the Society for the Encouragement of Arts, &c. is an ample description of this vessel, to which we are indebted for the following abstract:

" The length is, generally, thirty feet; the breadth, ten feet; the depth, from the top of the gunwale to the lower part of the keel in midships, three feet three inches; from the gunwale to the platform *(within,)* two feet four inches; from the top of the stems (both ends being similar) to the horizontal line of the bottom of the keel, five feet nine inches. The keel is a plank of

* See the article Boats, in Chapter I, page 9.—As the Barge is similar in its figure to the Pinnace, it was unnecessary to give a draught of the former; the latter serving for both.

three inches thick, of a proportionate breadth in midships, narrowing gradually toward the ends, to the breadth of the stems at the bottom, and forming a great convexity downwards. The stems are segments of a circle, with considerable rakes. The bottom section, to the floor heads, is a curve fore and aft, with the sweep of the keel. The floor timber has a small rise, curving from the keel to the floor heads. A bilge plank is wrought in on each side, next the floor heads, with a double rabbet or groove, of a similar thickness with the keel; and, on the outside of this, are fixed two bilge-trees, corresponding nearly with the level of the keel. The ends of the bottom section form that fine kind of entrance observable in the lower part of the bow of the fishing boat, called a *coble*, much used in the North. From this part to the top of the stem, it is more elliptical, forming a considerable projection. The sides, from the floor heads to the top of the gunwale, flaunch (or flair) off on each side, in proportion, to about half the bread of the floor. The breadth is continued far forward towards the ends, leaving a sufficient length of straight side at the top. The sheer is regular along the straight side, and more elevated towards the ends. The gunwale, fixed on the outside, is three inches thick. The sides, from the under part of the gunwale, along the whole length of the regular sheer, extending twenty-one feet six inches, are cased with layers of cork, to the depth of sixteen inches downwards; and, the thickness of this casing of cork being four inches, it projects at the top a little without the gunwale. The cork, on the outside, is secured with thin plates or slips of copper, and the boat is fastened with copper nails. The thwarts, or seats, are five in number, double banked, consequently the boat may be rowed with ten oars *. The thwarts are firmly stantioned. The side oars are short †, with iron tholes and rope grommets, so that each rower can pull either way. The boat is steered with an oar at each end; and the steering oar is one-third longer than the rowing oar. The platform placed at the bottom, within the boat, is horizontal, the length of the midships, and elevated at the ends, for the convenience of the steersman, to give him a greater power with the oar. The internal part of the boat next the sides, from the under part of the thwarts down to the platform, is cased with cork; the whole quantity of which, affixed to the Life Boat, is nearly seven hundred weight. The cork indisputably contributes much to the buoyancy of the boat, is a good defence in going alongside a vessel, and is of principal use in keeping the boat in an erect position in the sea, or rather of giving her a very lively and quick disposition to recover from any sudden cant or lurch which she may receive from the stroke of a heavy wave. But, exclusive of the cork, the admirable construction of this boat gives it a decided preference. The ends being similar, the boat can be rowed either way; and this peculiarity of form alleviates her in rising over the waves. The curvature of the keel and bottom facilitates her movement in turning, and contributes to the ease of the steerage, as a single stroke of the steering oar has an immediate effect; the boat moving, as it were, upon a centre. The fine entrance below is of use in dividing the waves, when rowing against them; and, combined with the convexity of the bottom, and the elliptical form of the stem, admits her

* Five of the benches only are used, the boat been generally rowed with ten oars.

† The short oar is more manageable in a high sea than the long oar, and its stroke is more certain.

to rise with wonderful buoyancy in a high sea, and to launch forward with rapidity, without shipping any water, when a common boat would be in danger of being filled. The flaunching, or spreading form of the boat, from the floor heads to the gunwale, gives her a considerable bearing; and the continuance of the breadth well forward, is a great support to her in the sea: and, it has been found, by experience, that boats of this construction are the best sea boats for rowing against turbulent waves. The internal shallowness of the boat, from the gunwale to the platform, the convexity of the form, and the bulk of cork within, leave a very diminished space for the water to occupy; so that the Life Boat, when filled with water, contains a considerably less quantity than the common boat, and is in no danger either of sinking or overturning. It may be presumed, by some, that, in cases of high wind, agitated sea, and broken waves, a boat of such a bulk could not prevail against them by the force of the oars; but the Life Boat, from her peculiar form, may be rowed ahead, when the attempt in other boats would fail. Boats of the common form, adapted for speed, are of course put in motion with a small power, but, from want of buoyancy and bearing, are over-run by the waves and sunk, when impelled against them; and boats constructed for burden meet with too much resistance from the wind and sea, when opposed to them, and cannot, in such cases, be rowed from the shore to a ship in distress. An idea has been entertained, that the superior advantages of the Life Boat are to be ascribed solely to the quantity of cork affixed. But this, which is a very erroneous opinion, has been refuted by the preceding observations on the super-eminent construction of this boat. It must be admitted, that the application of cork to common boats would add to their buoyancy and security; and it might be a useful expedient, if there were a quantity of cork on board of ships, to prepare the boats with, in cases of shipwreck, as it might be expeditiously done, in a temporary way, by means of clamps, or some other contrivance. The application of cork to some of the boats of his Majesty's ships * might be worthy of consideration; more particularly as an experiment might be made at a little expence, and without inconvenience to the boats; or may prevent pleasure boats from upsetting or sinking.

The Life Boat is kept in a boat-house, and placed upon a convenient carriage ready to be moved at a moment's notice. That at Scarborough is under the direction of a committee; and twenty-four Fishermen, composing two crews †, are alternately employed to navigate her. A reward, in cases of shipwreck, is paid by the committee to each man actually engaged in the assistance; and it is expected that the vessel receiving assistance should contribute to defray this expence.

The boats of this description, in general, are painted white on the outside; this colour more immediately engaging the eye of the spectator, at her rising from the hollow of the sea, than any other. The bottom of the boat is at first varnished, (which will take paint afterwards,) for the more minute inspection of purchasers. The oars she is equipped with are made of fir, of the best quality, it having been found, by experience, that a rove ash oar that will dress clean and

* The Launches.

† Two crews are appointed, that there may be a sufficient number ready in case of any absence.

light, is too pliant among the breakers; and, when made strong and heavy, from rowing double banked, the purchase being short, sooner exhausts the rower, which makes the fir oar, when made stiff, more preferable.

In the management of the boat, she requires twelve men to work her; that is, five men on each side, rowing double banked, with an oar slung over an iron thole, with a grommet (as provided,) so as to enable the rower to pull either way; and one man, at each end, to steer her, and to be ready at the opposite end to take the steer oar, when wanted. As, from the construction of the boat, she is always in a position to be rowed either way, without turning the boat, when manned, the person who steers her should be well acquainted with the course of the tides, in order to take every possible advantage: the best method, if the direction will admit of it, is to head the sea. The steersman should keep his eye fixed upon the wave or breaker, and encourage the rowers to give way as the boat rises to it; being then aided by the force of the oars, she launches over it with vast rapidity, without shipping any water. It is necessary to observe, that there is often a strong reflux of sea, occasioned by the stranded wrecks, which requires both dispatch and care in the people employed, that the boat be not damaged. When the wreck is reached, if the wind blows to the land, the boat will come in shore without any other effort than steering.

The great ingenuity which has been displayed in the construction of the Life Boat, leaves scarcely any room for improvement; but some have supposed, that a boat of twenty-five feet in length, with a proportionate breadth, would answer every purpose of a larger one. A boat of these dimensions would certainly be lighter and less expensive; but whether she would be equally safe and steady in a high sea is, perhaps, uncertain.

The great utility of the Life Boat has been proved in many instances, especially off the different ports of the northern coast, particularly at Shields, Sunderland, Scarborough, Lowestoffe, &c. where many valuable lives have been saved from the most perilous situations *. In such cases the crew are so well satisfied with the performance, and so confident in the safety, of the boat, that they fearlessly adventure upon the most dangerous occasions.

The Life Boat has been particularly patronized by his Grace the Duke of Northumberland, who had that for North Shields, which he has endowed with an annuity, built at his own expence. His Grace had also another built, which was sent to Oporto. The *Northumberland Life Boat*, so called from its having been built at the Duke's expence, was first employed in November, 1798, when she went off to the relief of the sloop Edinburgh, of Kincardine, which was seen to go upon the Herd Sand, about a mile and a half from shore. This vessel was brought to an anchor before the Life Boat got to her; and she continued to strike the ground so heavily, that she would not have held together ten minutes longer, had not the Life Boat arrived: the cable of the sloop was then cut, and seven men taken out and brought on shore through a sea so enormously high that no other boat could have lived in it. In the event of the boat's filling with water, she

* For an account of many of these cases, see "Transactions of the Society for the Encouragement of Arts," &c. Vol. 20, or "Naval Chronicle," Vol 9, page 285, in either of which may be found a detail of numerous interesting particulars relative to this excellent invention.

will not founder as boats of a common construction would do; and, although she has gone off scores of times she never failed in bringing off such crews as staid by their ships. These circumstances have been particularly evinced in several instances; wherein she has been filled with water to the midship gunwale, and all have been landed without injury.

In testimony of the national utility of the Life Boat, Mr. Greathead has been honoured by Parliament with the sum of twelve hundred pounds; and, by the Society for the Encouragement of Arts, with a gold medal and fifty guineas; likewise with the Medallion of the Royal Humane Society, and other especial marks of the public approbation and gratitude*.

* We have been recently informed, that his Imperial Majesty of Russia, and his Majesty the King of Prussia, have transmitted to Mr. G. very handsome testimonials of their sense of the great importance of his invention.

THE

ELEMENTS AND PRACTICE

OF

NAVAL ARCHITECTURE.

BOOK THE SECOND.

CONTAINING THE PRACTICAL RULES FOR THE CONSTRUCTION OF SHIPS AND VESSELS; WITH ALL THE REQUISITE TABLES, &c.

CHAPTER I.

GENERAL OBSERVATIONS AND DEFINITIONS.

THE first step towards building a ship from design is, to construct draughts for that purpose, namely, plans and sections drawn with all possible exactness, examined by proper calculations, and fit to be submitted to the most accurate scrutiny.

Of these, the principal are; first, the SHEER DRAUGHT, or plane of elevation, upon which the whole length of the ship is represented, according to a side view, perpendicular to the keel, as upon a section supposed to be cut by a plane passing through the middle line of the keel, stem, and stern-post. *(See Plate* 1.*)*

Secondly, the BODY PLAN, or plane of projection, in which the ship is exhibited according to an end view, so as to present the outlines of her principal timbers, and shewing the projection of her frames relatively to each other. It is supposed to be described on a vertical section, at the midship bend, or broadest part of the ship, perpendicular to the sheer plan, and comprehends a delineation of the shape of every frame timber in the ship.

Thirdly, the HALF BREADTH OR FLOOR PLAN, supposed to be described by an horizontal section cutting the whole body of the ship, lengthwise, at the broadest place on each timber. On this draught, which is generally placed under the sheer draught, are described all the sections or curves that may be imagined to cut the ship horizontally, lengthwise, &c. In this draught the curves of the transoms, called the *Round-Aft*, are also marked, and sometimes the breadth and thickness of the timbers. It is called the *Floor Plan*, as being that on which the whole frame is supposed to be erected, and as exhibiting the upper side of the keel, with all the floors, &c.

To the above may be added, the draughts exhibiting the Disposition of the Frame Timbers and Planking; the profile of the Inboard Works, or interior of the ship; the Plans of the Decks, &c.

From the foregoing definitions it may readily be conceived, that the *Sheer Draught* determines the length and depth of the keel; the difference of the draughts of water; the length and projection, or *rake*, of the stem and stern post; the position of the midship and other frames upon the keel; the load water and other water lines; the wales; the dimensions and situations of the ports; the projection of the rails of the head and stern gallery, with the stations of the masts and channels. That the *Body Plan* limits the different breadths of a ship in various points of her length, and exhibits the outline of the timbers respectively to each other, as they are erected upon the keel, with a variety of sections of the ship in different parts of her length, and always perpendicular to the surface of the water; so that the eye of the observer, when placed in what may be properly termed the longitudinal axis of the ship, may perceive the several sections at one glance; that is to say, when looking full on the stem, from before the ship, he shall distinguish all the fore timbers, or those in the fore-body; and, when looking from behind, directly on the stern, he shall perceive all those of the after-body. But, as the two sides of a ship ought to be exactly alike, it is judged sufficient to represent the sections of the fore part of the ship on the right side, and those in the after part on the left side, so as to perceive all the sections, as well afore as abaft, upon one plane.

With respect to the horizontal plane, or *Half Breadth Plan*, it may also be observed, that, when a ship floats upon the stream, it is evident that her upper works will be separated from the bottom by the surface of the water, which will accordingly describe an imaginary horizontal line upon the bottom from the stem to the stern-post.

The most elevated of these lines is that, called the *load water line*, which is supposed to be drawn by the surface of the water on the upper part of the bottom when she is fully laden.

If the ship be lightened of any part of her lading, and preserves the same difference in her draught of water at the two ends, or so as to preserve the same equilibrium of the keel with regard to the surface of the water, another line may be delineated upon the bottom, close to the surface of the water, which will be a second water line, parallel to the first, but nearer to the keel in proportion to the height which the ship has risen. Thus may a variety of water lines be drawn parallel to each other and to the load water line.

The construction of these, and of the other lines described on the three principal draughts, will be more fully understood by the following definitions, &c. which may be considered as supplementary to those given in the first chapter of Book I.

The Height of Breadth is, as before explained, the main breadth or broadest part of the ship, and is defined by two curved lines, called the Upper and Lower Height of Breadth Lines, as heretofore described.

The MAIN HALF BREADTH is a section, supposed to cut one half of the ship horizontally at the height of breadth. It comprehends, therefore, the broadest part of the ship from the middle line to the outside of every timber.

The TOP-TIMBER LINE is a curve which generally terminates the height of the ship amidships, and also describes the sheer; it is likewise where the top timber half breadth section, described beneath, cuts the ship fore and aft, or lengthwise.

The TOP-TIMBER HALF-BREADTH is a section of one half of the ship, supposed to cut the ship horizontally at the height of the top-timber line.

WATER LINES are, as we have explained above, supposed to be drawn on the surface of a ship's bottom by the surface of the water on which she floats. They are generally drawn with green ink, and are represented in the sheer draught by straight lines. If parallel to the keel, they will be represented on the body-plan by horizontal lines; but, if the vessel is to be constructed so as to draw most water abaft, the water lines will not, of course, be parallel to the keel, but, owing to their varying heights, will form curves upon the body plan; and, in the half-breadth plan they will be described by curves which limit the half breadth of the ship at the height of their corresponding lines in t e sheer plan.

RIBBAND LINES are those curved lines, in the half breadth plan, by which moulds are made for the ribbands and harpins; and, the use of the ribbands and harpins is, to keep the mbers which compose the body of the ship to their true stations, so as to preserve its rue form until the plank is brought on. For this purpose they are skilfully arranged with egard to their heights and distances from each other. It is evident that the ribbands will partake of a double curve, owing to the convexity of the bottom of the ship. The curve, in the sheer plan, will increase perpendicularly on approaching the stem and stern post; and it will be clear that, by deviating from the middle line of the ship's length, as they approach the extreme breadth, the ribbands will also form an horizontal curve, as upon the half breadth plan. From this double curve it results, that the ribbands will appear in different points of view, when drawn upon different plans of the same ship. To conceive this, suppose a model of a ship upon the stocks completely framed as represented in the frontispiece. If we were placed in a line prolonged from the keel, facing either the stem or stern, we should only view the projection of the ribbands on the plane of the midship frame, in which the horizontal curve is scarcely seen, but we shall discover part of the perpendicular curve which rises gradually from the extreme breadth towards the stem and stern post, so that they must be drawn on the body plan as *diagonal lines*, which terminate on the midship frame, and, at the heights designed on the stem and stern-post. But, if we were placed considerably above the ship, on a line perpendicular to the middle of the keel, we should discern the horizontal curve ás drawn in the half breadth plan, without perceiving the perpendicular curve as drawn in the sheer plan.

SWEEPS. The different sweeps or segments of circles which successively and connectively form a bend, or frame of timbers, have already been clearly described under the article FRAMES, in Chapter I. Book I. Of these, the segment which is called the FLOOR SWEEP is that which forms the body at the floor head, particularly along the midships. It is limited by a horizontal line above the keel in the body-plan, and its distance above the keel at the midship timbers is called the *Dead-Rising*.

The Lower Breadth Sweep forms that part of the body immediately below the lower height of breadth. Its centre is found in a horizontal line, in the body plan, at the height of the lower breadth of its corresponding timber in the sheer plan, upon which line is set off the main half breadth of the ship, and from which the radius is taken that describes the sweep downwards.

The Reconciling Sweep connects the lower breadth and floor sweeps in such a manner as to intersect neither, but to come exactly over the back of each, so that the whole form a fair curve from the lower height of breadth down to the rising or floor sweep; and, by drawing a line from the back of the floor sweep down to the keel, we shall have the whole form of the timber below the lower height of breadth line.

The Upper Breadth Sweep forms part of the body above the upper height of breadth. The centre of this sweep is in a horizontal line, in the body plan, corresponding with the upper height of breadth of the same timber in the sheer plan; to which line the corresponding main half breadth of each timber is squared up. Within this half-breadth is set off the radius or length of the sweep which gives the centre for describing as much of a circle upwards as is required. The lengths of all the upper breadth sweeps are to one radius.

The Top-timber Sweep or Hollow, is a sweep inverted with its back to the back of the upper breadth sweep; its upper part intersects a spot at the top-timber half breadth at the height of the top-timber line. By this sweep, as we have before shewn, the form of the timber is completed.

The RISING of the Floor, is a curve drawn in the sheer-plan and limited at the midships by the dead-rising. In flat floored or burthensome ships it runs nearly parallel to the keel for some distance afore and abaft the midships. All the timbers where the rising is parallel with the keel are termed *flats*.

The Half Breadth of the Rising is a curve line in the half breadth plan which limits the distance of the centres of the floor sweeps from the middle line in the body plan.

The Rising Line is a curve in the sheer draught which contains the heights of the centres of the floor sweeps, taken from the body-plan; but, if the whole height of those centres was set off upon corresponding timbers in the sheer-plan, they would interpose with the upper lines in the draught; the rising line is, therefore, so contrived as to come to the lower part of the sheer-plan, by taking all the heights of the centres in the body-plan, from a horizontal line, at the height of the centre which sweeps dead-flat; and, setting them off on their corresponding timbers in the sheer-plan, from the upper edge of the rabbet of the keel, by which means the rising line in the midships breaks in fair with the upper edge of the rabbet of the keel. When the body is constructed by a rising floor, the floor sweeps are all of one length.

The Cutting down line is a curve line, in the sheer plan, which limits the height of every floor timber at the middle line; and, likewise, the height of the upper side of the deadwood afore and abaft, which must be sufficiently high to allow for the siding of the keelson, and leave sufficient strength in the rising floors.

ROOM AND SPACE, or Timber and Room, is the distance between the moulding edges of all the timbers; or, rather, the siding of every two timbers and opening between: the timber being considered as the *Space* and the opening between as the *Room*. The Room and Space accordingly varies with the size of the ship; and, it must always be contrived, in draughting, so as to contain the siding of two timbers and the opening between, agreeably to the definition. In all ships of war, the width of the ports must here be always considered. It may be observed, that one mould serves for two timbers, the foreside of the one being supposed to unite with the aftside of the other, and so forming only one line, which is called the joint of the frame or timbers. The midship timber, or broadest part of the ship, is called dead-flat, and distinguished by this character ⊕. The timbers before the midship are distinguished by the letters A, B, C, &c. and those abaft the midship by the figures 1, 2, 3, &c. Those timbers following dead-flat, both afore and abaft, where there is no rising, are called flats, and are distinguished by the characters (A), (B), &c. in the fore body, and (1), (2), &c. in the after body. It may be generally observed, that all particulars in the fore body are distinguished by letters of the alphabet, and all those in the after body by *figures*. Thus the cant timbers in the fore body are commonly distinguished by a, b, c, &c. and those in the after body by small figures.

The foregoing is an explanation of the principal draughts and of the principal lines made use of in their formation. But, previous to the construction of the draughts of a ship, intended to carry a certain determinate burden, there are several points of the utmost importance which ought to be considered and ascertained; namely, the quantity of displacement and tonnage when the ship is laden and floats on the water; the centre of displacement or cavity; the centre of gravity of the ship; together with the determination of the meta-centre or point of stability: by all of which, connectively, the stability of the vessel and her power to carry sail may be estimated. The consideration and determination of these points become, therefore, the subject of our next chapter.

CHAPTER II.

PRACTICAL METHODS OF FINDING THE GRAVITY, DISPLACEMENT, AND TONNAGE, OF A VESSEL; INCLUDING THE CENTRES OF GRAVITY AND DISPLACEMENT; WITH THE POINT OF STABILITY, OR META-CENTRE.

§ 1. EXPLANATORY REMARKS ON THE CENTRE OF GRAVITY, AND THE MEANS OF FINDING IT IN DIFFERENT FIGURES.

WE have already explained, in our first chapter, the nature of gravity, &c. but it may not, perhaps, be superfluous to give here some farther elucidation of those subjects.

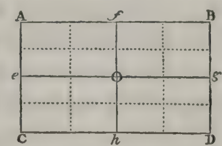
From what has been said, on the nature of gravity *, it may readily be conceived, that the same quantity of matter may appear under different forms, but having still the same weight. For a piece of lead, in form of a globe, of one inch diameter, may be extended so as to cover a circle of one foot or more in diameter; but, it is evident, that the lead will be of the same weight in both forms; and, if it were possible to press it so as to become a globe of one eighth of an inch diameter, or less, this small globe would weigh as much as the greater one: but, because the parts of matter cannot penetrate into one another, this cannot be effected. Let us then suppose the whole weight of a globe to be concentered into one point, or exact centre of itself, and we shall then have a correct idea of what is called its *centre of gravity*.

The centre of gravity then, of any body, is that point, upon which, if it was supported, or by which, if suspended, it would rest immoveable in any situation, as if the weight of the whole body was united in it. Hence, to find the centre of gravity of any body is, to find that point, upon which, if the body rests, all the parts will be in equilibrium.

It follows, that the centre of gravity of a line or beam, as A B, is in the middle of its length; so that, if supported by a fulcrum in the centre, it would hang in equilibrio, as a balance, and the point of support will be the axis of the equilibrium: and if, in this situation, a weight, equally distributed, as at A and B, were laid upon it, the balance would still be the same. By supposing a plane to cross the beam in the point of support, we shall have an idea of the plane of the equilibrium; that is to say, of a plane in which the centre of gravity is to be found.

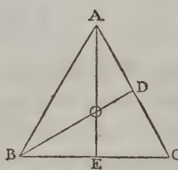
* See the Article GRAVITY, in Chapter I. Book I.

Upon the same principle, it may be readily shewn, that the centre of a parallelogram is at O: for, supposing the parallelogram to be formed by elementary lines parallel to A B, as *e g*, the middle point of each will describe the line *f h*, the axis of the equilibrium in which the centre of gravity of the whole figure must certainly be found. Let us then suppose other elementary lines, parallel to BD, and we shall then have another axis of the equilibrium, in which, likewise, the centre of gravity must be; and, because the point O is the only one common to both axes, it must be the centre of gravity: hence the centre of gravity of a parallelogram must be in the centre of the figure. For the same reasons, the centre of gravity of circles, ellipses, and polygons, of any even number of sides, will be in the centre of their respective figures.

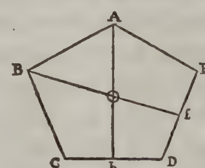


Again, if we suppose, as shewn in the foregoing figure, an assemblage of similar parallelograms, the centre of gravity or momenta of the whole, collectively, will, of course, be found in the point O.

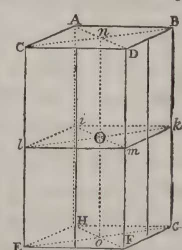
From what has been said it will be clear, that the centre of gravity of any triangle may be readily found; for, if we bisect any two sides by lines continued to the opposite angle, as the sides A C or A B by the lines D B and A D, the point of intersection O will be the centre of gravity of the triangle.



Again, in the regular pentagon A B C D E, we shall have the axis A *h* and the axis B *f*; so shall O, the intersection of the two axes, be the centre of gravity of the pentagon.



As, by the foregoing simple methods we may find the centres of gravity of regular surfaces; so, if we consider surfaces as the elements of solids, we may as easily find the centres of gravity of solids. For, if we conceive the parallelopiped, represented in the margin, to be formed by an infinite number of parallelograms, parallel to A B C D, the centre of gravity of all the parallelograms will be in the centre of each figure, as before shewn; and, if we draw a line, *n o*, through all the centres of gravity, we shall have the axis of the equilibrium in which the centre of gravity of the parallelopiped is to be found. Now, as all the parallelograms are equal, we may conclude that the centre of gravity of the parallelopiped is in the middle of the axis *n o*, at O. For the same reason, the centres of gravity of a cylinder, of a sphere, or of an ellipsoid will be found exactly in the centre of these solids.



As any prism may be considered as composed of surfaces, or thin slices, equal and similar to the area of its bases, a straight line drawn from the centre of one base to that of its opposite, will pass through all the elementary slices; and, therefore, the centre of gravity of all prisms, or cylinders, will be in the middle of that line, which is the axis of the equilibrium.

With respect to a triangular pyramid, it is obvious, that its centre of gravity will be found in a straight line drawn from the vertex to the centre of the base. For, supposing the pyramid to be divided into elementary slices, parallel to the base, the centres of gravity of all these surfaces will be similarly placed, and, using the same operation on all sides of the pyramid, we shall obtain the axes of the equilibrium, whose point of intersection, at one-fourth of the length from the base will be the centre of gravity. A Cone may be considered as a pyramid, having an infinite number of sides, and its centre of gravity will consequently be found also at one fourth of its axis from the base.

The Centre of Gravity of a ship, although a very irregular body, may be very nearly found by an application of the principles which we have here explained; namely, by finding the areas and momenta of different horizontal and perpendicular sections, each of which is supposed to be divided into figures so nearly regular that their differences shall be of little or no consequence in practice.

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§ 2. OF THE GRAVITY, DISPLACEMENT, AND TONNAGE, OF A SHIP, &c.

As, in all ships of war there is a fixed height for the lower sill of the midship port above the load-water line, with six months stores, provisions, &c. on board, their capacity should be simply adequate for this purpose, neither more or less; it should not be more, to avoid superfluous expence in construction and the additional number of men required to navigate; nor should it be less, from an obvious general insufficiency to answer the required purposes; the bias should rather lead to increase than diminish in capacity. In merchant ships an exact estimation of their capacity is more frequently required to regulate the port duties and the contracts between merchants and owners and builders, than to insure them stiffness, a fixed line of floatation and fast sailing, as the charge may be regulated by their ability to support it, and their load-water line may be considerably varied without any hurtful interference with other essential requisites.

We have already explained that, by the laws of hydrostatics, every floating body displaces a quantity or weight of water equal to its entire weight; nothing more is therefore required, for the determination of the capacity of a ship of war, than to ascertain when she is loaded to her deep or load water mark; that is, when all her ammunition, provisions, stores, men, &c. are on board, and the ship, in all respects, ready for sea.

Hence, if we observe, what draught of water a ship draws when she is laden, with every thing on board, and supposed to be immersed to her deep water mark, or load water line, we shall have only to find a method whereby we may come at the true number of cubic feet contained in the ship below that line; which, consequently, will be the number of cubic feet in the bulk of water displaced by the ship in that position: whence, by calculating the weight of so many cubic feet of water, we shall obtain the true weight of the ship with every thing on board, and all that leans or presses upon her.

Now, as ships of the same number of guns and tons, are nearly of the same dimensions, we may, by knowing the weight of such a ship, compare it with the estimated weight of a ship, the plans of which we have constructed, by examining the draught of water, and computing the weight therefrom. If the weight be found to agree with the known weight of that of similar size, the load water line may be considered as rightly placed; and, we shall know, for a certainty, how much water she will draw when brought down to her load water mark; in consequence, we may determine on the height of the lower deck ports, by which the true placing of the decks, &c. must be regulated.

But, if the weight, as laid down in the draught, exceeds the weight first mentioned for ships of a similar size, the load water line in the draught is placed too high, and must be lowered till both the weights are found to agree: for the same reason, if the weight of the ship, in the draught, appears to be less than the weight first mentioned, the water line will be then too low, and must be raised accordingly.

The ship may be laid down in the draught either so as to sail on an even keel or so as to draw most water abaft; but the larger classes, in general, are recommended to be constructed for an even keel, as we have before noticed, having thus the advantage both with respect to strength and velocity. For, if a ship constructed to sail by the stern, be brought down to her load water mark so as to sail on an even keel, her strength and sailing qualities will be considerably diminished; and, the fore part, being brought down lower than it should be, the middle of the ship maintaining its proper depth in the water, the after part must be, by these means, lifted, and will press downwards with a strain which may continue until the ship's sheer is entirely broken. It is probable, that, from this reason, we see so many ships, after having sailed a little while, with broken backs (as it is termed;) that is, with their sheers altered in such a manner, that the sheer rounds up, and the highest part is in midships.

Such are the disadvantages arising from not paying a due attention to those points in the construction of a draught; therefore, when the load water line is found to be situated of a proper height on the draught, according to the weight given, and likewise drawn parallel to the keel, as supposing that to be the best sailing trim, the next matter will be to examine whether the body is constructed suitably thereto, in order to avoid the ill consequences which we have noticed.

For this purpose we must, in the first place, divide the ship equally in two, lengthwise, between the fore and after perpendiculars described on the draught; and, the exact number of cubic feet in the whole bottom beneath the load water line being known, we must find whether the number of cubic feet in each part so divided is the same; if they prove to be so, the body of the ship may then be said to be constructed in all respects suitably to her swimming on an even keel, let the shape of the body be whatever it may, and which will be found to be her natural position at the load water line.

But, if one of the parts should contain a greater number of cubic feet than the other, that part which is the heaviest will sink the deepest, supposing the ship in her natural position. Then, in order to render the ship suitably constructed to the load water line in the draught, (which is parallel to the keel) we must subtract the number of cubic feet contained in the lesser part, from the number contained in the greater part, and then fill out that part of the body which contains the lesser quantity, till it has accumulated half the sum of the difference, and draw in the other part of the body proportionably, so as to make both parts equal. Thus will the ship's body be so constructed as to swim on an even keel.

Also, if we propose that a ship, to be laid down, shall not swim on an even keel, but draw more water abaft than afore, we must then, by comparing the fore and aft parts of the ship's body together, swell out the one part of the body and reduce the other; so that the ship shall have her natural position when brought down to the load water mark, as required.

It has sometimes been supposed that, to construct a draught is no more than to draw the several lines which compose the whole, and form the representation of the sheer draught, half-breadth, and body plans at discretion, shaping them in such a manner as only to answer particular purposes, as stowage, dispatch, &c. without the least attention to some considerations which are most essential to every class of shipping. A ship thus constructed, if put together as strongly as possible, and by the most skilful workmen, and likewise with the best materials, would not, unless by mere chance, answer the wished for purposes so well as one put together in a more unskilful manner, and with more unsound materials, but constructed agreeably to the dictates of theory and experience. Because the latter would always wear easy, by being kept in her natural position and free of compulsion; whereas, on the contrary, the former might, by continual strains, in consequence of her body being irregularly formed, be wearing herself to pieces, and trying every part to the greatest degree; and, by the time that the strength of the latter began to decline, the first would not be in value equal to one half of the value of the other ship.

In order that the student may not fall into such errors, we shall endeavour to reduce the theory of what has been said into practice, by which he may be able easily to go through the whole process, and thence be convinced of the propriety of these considerations in the constructing or forming of a ship's body.

It will be necessary, in the first place, to calculate the weight of a ship, ready equipt for sea, from the knowledge of the weight of every thing in her, and belonging to her, as the exact weight of all the timber, iron, lead, masts, sails, rigging, and, in short, of all the materials, men, provisions, and every thing else on board her, from which we shall be able to judge afterwards of the truth of our calculations, and likewise whether our load-water line in the draught be placed agreeably thereto.

The draught which we shall make use of to make our computations from, will be that of the eighty-gun ship. *(Plate 1.)*

In order to ascertain the weight of the hull, the timber is the first article which comes under consideration; we must, therefore, make a true calculation of every cubic foot of timber contained in the whole fabric; which we shall be able to do by means of the draughts, and the principal dimensions and scantlings; observing to distinguish the different kinds of timber from each other, as they differ considerably in weight; and, then reducing the number of cubic feet contained in the different sorts of timber into pounds, and adding them together, the true weight of the timber will be found. In the same manner may the weight of all other particulars, as iron, lead, paint, &c. be found, and the true weight of the whole obtained.

In reducing quantity into weight it must be understood that a cubical foot of oak is equal to 925 ounces or $57\frac{3}{4}$ pounds, and that other bodies are to each other in the proportions stated under the article Specific Gravity, in Chapter I. of the first Book.

It must be admitted that, to obtain the weight of a ship in this manner, is a laborious task; and, that difficulties may arise in the trial thereof, which cannot be gotten over by many persons, who are not conversant in mensuration; as, in the measuring so many pieces of timber that compose a ship, there are many figures extremely irregular; and, therefore, as we cannot enter so fully into the subject as its nature would admit, we shall, for the better information of that part of our readers, as well as of those who are not disposed to give themselves the trouble of such a trial, lay down the weight of the eighty-gun ship of two decks, as calculated, and as supposing her to be brought down to the load-water line, with provisions, ammunition, men, &c. on board, and in all respects fit for sea.

AN ESTIMATE of the WEIGHT of the EIGHTY-GUN SHIP, as fitted for Sea, with Six Months' Provision, &c.

Weight of the Hull.

	No. of feet	No. of lbs.	Tons.	lbs.
Oak Timber, at 57 lb. 13 oz. to the cubical foot	48497	2803733	1251	1493
Fir Timber, at $34\frac{1}{4}$ lbs. to the cubical foot	4457	152652	68	332
Elm Timber, at $37\frac{1}{2}$ lbs. to the cubical foot	520	19500	8	1580
Carved work and lead work	—	4651	2	171
Iron Work, rudder irons, chain plates, nails, &c.	—	88254	39	894
Pitch, tar, oakum, and paint	—	17920	8	0
Cook room, fitted with fire-hearth, &c.	—	16123	7	443
Total		3102833	1385	433

Weight of the Furniture.

	No. of lbs.	Tons.	lbs.
Complete set of masts and yards with the spare geer	161000	71	1960
Anchors with their stocks and master's stores	39996	17	1916
Rigging	69128	30	1928
Sails, complete set with spare	32008	14	648
Cables and hawsers	73332	32	1652
Blocks, pumps, and boats	62056	27	1576
Total	437520	195	720

Weight of the Guns and Ammunition.

	No. of lbs.	Tons.	lbs.
Guns with their carriages	377034	168	714
Powder and shot, powder barrels, &c.	116320	51	2080
Implements for the powder	6500	2	2020
Implements for guns, crows, handspikes, &c.	21573	9	1413
Total	521427	232	1747

Weight of the Officers' Stores, &c.

	No. of lbs.	Tons. lbs.
Carpenter's stores	20187	9 27
Boatswain's stores	21112	9 952
Gunner's stores	8964	4 4
Caulker's stores	5200	2 720
Surgeon's and Chaplain's effects	11096	4 2136
Total	66559	29 1599

Weight of the Provisions.

	No. of lbs.	Tons. lbs.
Provisions for six months for 700 men, with water, casks, and Captain's table	1388828	620 28

Weight of the Men, &c.

	No. of lbs.	Tons. lbs.
700 men, including the officers, and their effects	228673	102 193
Ballast	1411200	630 —
Total	1639873	732 193

RECAPITULATION.

	No. of lbs.	Tons. lbs.
The Hull	3102833	1385 433
The Furniture	437520	195 720
Guns and ammunition	521427	232 1747
Officers' stores	66559	29 1599
Provisions	1388828	620 28
Weight of the men and ballast	1639873	732 193
Total	7157040	3195 240

We now find, agreeably to the above estimate, that the eighty-gun ship weighs, when brought down to her load water line, with every thing on board, and fit for sea, 7157040 pounds, or 3195 tons; and may therefore now know, to a certainty, if the load water line in the draught be properly placed, only by reducing the immersed part of the bottom into cubic feet; for, if the eighty-gun ship weighs, when brought down to the load water line, 3195 tons, she must sink so far into the water till she has displaced a column of water weighing 7157040 pounds, or 3195 tons; and, a cubic foot of salt water being supposed to weigh $64\frac{3}{8}$lbs, we shall therefore find that, if we divide 7157040 by $64\frac{3}{8}$, the quotient will be 111177 feet, which is the bulk of that column of water which she should displace when brought down to her load water line; or, if she displaces 111177 cubical feet, we may then conclude that she weighs 3195 tons.

We should, therefore, always make an exact calculation of the contents of the immersed part of a ship's bottom, before we determine on the place of the decks and other works, as there can be no dependance placed on their situation with respect to the load water line, until such calculation be made.

The solid contents of a ship's body, were it any regular figure, might be very easily found geometrically; but as it is quite otherwise, we must be satisfied with taking the trouble of dividing it into parts, of which we may have so many, that they may be considered as regular figures in the admeasurement, and limited by straight lines, although some are actually curves.

In the draught of the eighty-gun ship, the bottom is divided on the plane of elevation into several parts; vertically, by the lines that represent the frames, and, horizontally, by the water lines; so that the whole may be said to be divided into so many parallelopipedons, limited at one end by a plane, supposed to be erected vertically upon the keel; and, at the other end, by the round of the outside of the ship, and their upper and lower surfaces by the water lines.

Now, it is plain, that the area of the surface which limits the lower part of this solid, is less than the area of the surface which limits the upper part; we must, therefore, add both the areas together, and take one half of the product for a mean area, which, if multiplied by the depth of the solid, that is, the distance between the two surfaces, will produce the contents of the solid in cubic measure; then, by finding the contents of every solid in the same manner, and adding them together, we shall have the solid contents of one side, and, by doubling the sum, have the solid contents of the whole bottom.

But, as it is so very tedious in the operation to find the contents of every parallelopipedon singly, we shall introduce a method whereby we may find the contents of all the surfaces which are contained on the same plane at once; that is, by one operation, to find the area of the whole surface formed by the horizontal section or water line, except that part intercepted betwixt the aftermost frame and the post, and the part contained betwixt the foremost frame and the stem, which, on account of their forming such irregular figures, must be measured separately.

RULE. Take the length of every other one of the lines that represent the frames, in the half breadth plan, upon the upper water line; add them all together, except the foremost and aftermost, of each of which take only one half; then multiply the sum by the distance between the frames so taken, and the product will be the area of the water line contained betwixt the foremost and aftermost frames; then find the area of that part abaft the after frame which forms a trapezium, and also of the post and rudder; and, likewise, find the area contained in that part afore the foremost frame, and also of the stem and gripe; then add these last areas to the area first found; the sum, doubled, will be the area of the surface of the whole water line.

The areas of the other water lines may be found in the same manner; and, then, by adding all the areas into one sum, except the uppermost and lowermost, of each of which only one half must be taken, and multiplying that sum by the distance between the water lines, (observing that the water lines in the plane of elevation be equally distant and parallel to each other) the product will be the solid contents of that space contained between the lower and load water lines.

In the next place, add the area of the lower water line to the area of the upper side of the keel, and multiplying half the sum by the distance between them, the solid contents of that part will be found between the lower water line and upper side of the keel, supposing them parallel to each other; but, if the lower water line should not be parallel to the keel, the distance between them must be taken at every other frame, and added together; then, by dividing the sum by the number of frames so taken, the quotient will be a mean distance, by which the mean area is to be multiplied as before.

The solid contents of the keel may be next found; and, by adding that to the solid contents of the different parts before found, we shall have the whole number of cubic feet contained in the immersed part of the bottom, or that part below the load water line.

THE APPLICATION OF THIS METHOD, IN FINDING THE CUBIC FEET CONTAINED IN THE BOTTOM OF THE EIGHTY-GUN SHIP, BELOW THE LOAD WATER LINE.

The fore body is divided into four, and the after body into nine, equal parts, upon the Half Breadth Plan, or horizontal plane (see plate 1), besides the parts contained between timber 32 and the stern post, and timber Q, forward, and the stem.

The sheer-plan, or plane of elevation, is also supposed to be divided into five equal parts by water lines drawn parallel to the keel, all of which are formed on the half breadth plan.

Note.—A medium thickness must always be added to each line that represents the outsides of the timbers upon the half breadth plan, for the bottom plank; say five inches; which will be a mean between the thickness of the plank next the wales and that on the lower part of the bottom. It may also be observed, that the plank always measures full its thickness when measured upon a horizontal plane.

EXAMPLES.

1. To find the Areas of the Water Lines from Dead-flat aft.

Upper or Load Water Line abaft ⊕.

	ft.	inc.		
The Half Breadth at ⊕ is 24.10; of which one half is	12	5		
——— at Frame (5) is	24	10		
——— at Frame 4	24	10		
——— at Frame 8	24	8½		
——— at Frame 12	24	7½		
——— at Frame 16	24	6		
——— at Frame 20	24	3		
——— at Frame 24	23	8		
——— at Frame 28	22	6		
——— at Frame 32 is 20.9; of which one half is	10	4½		
Sum	216	8½		
Multiply by distance between the Frames	10	11		
Product; or Area to Frame 32	2365	8¾		

Area of the Part abaft Frame 32.

	ft.	inc.		
The Half Breadth at Frame 32 is 20.9; of which one half is	10	4½		
——— at Frame 33 is	20	1		
——— at Frame 34	19	3		
——— at Frame 35	18	2		
——— at Frame 36	16	5		
——— at Frame 37	13	4		
——— at Frame 38	7	8		
Post is 11 inches; the half is	0	5½		
Sum	105	9		
Multiply by distance betw. Ordinates	2	8¾		
Product; or Area abaft Frame 32	288	7¼	288	7¼
			2654	4
Half Area of Rudder and Post			5	6
			2659	10
Multiply by				2
Whole area of the Load Water Line from Dead-flat aft			5319	8

Second Water Line abaft ⊕.

	ft.	inc.		
The Half Breadth at ⊕ is 24.0; of which one half is	12	0		
——— at Frame (5) is	24	0		
——— at Frame 4	24	0		
——— at Frame 8	23	11		
——— at Frame 12	23	9½		
——— at Frame 16	23	6½		
——— at Frame 20	23	1½		
——— at Frame 24	22	3		
——— at Frame 28	20	7½		
——— at Frame 32 is 17. 4; of which one half is	8	8		
Sum	205	11		
Multiply by distance between the Frames	10	11		
Product; or Area to Frame 32	2247	11		

Area of the Part abaft Frame 32.

	ft.	inc.		
The Half Breadth at Frame 32 is 17.4; of which one half is	8	8		
——— at Frame 33 is	15	10		
——— at Frame 34	13	11		
——— at Frame 35	11	8		
——— at Frame 36	8	10		
——— at Frame 37	5	10		
——— at Frame 38	2	7		
Post is 10 inches; the half is	0	5		
Sum	67	9		
Multiply by distance betw. Ordinates	2	8¾		
Product; or Area abaft Frame 32	184	10½	184	10½
			2432	9½
Half Area of Rudder and Post			5	5
			2438	2½
Multiply by				2
Whole Area of the Second Water Line from Dead-flat aft			4876	5

Areas of the Water Lines from Dead-flat aft.

Third Water Line abaft ⊕.

	ft.	inc.
The Half Breadth at ⊕ is 22.2; of which one half is	11	1
—— at Frame (5) is	22	2
—— at Frame 4	22	2
—— at Frame 8	22	1
—— at Frame 12	21	10
—— at Frame 16	21	6
—— at Frame 20	20	10
—— at Frame 24	19	5
—— at Frame 28	16	6
—— at Frame 32 is 11.2, of which one half is	5	7
Sum	183	2
Multiply by distance between the Frames	10	11
Product; or Area to Frame 32	1999	6¾

Area of the Part abaft Frame 32.

	ft.	inc.		
The Half Breadth at Frame 32 is 11.2; of which one half is	5	7		
—— at Frame 33 is	9	4		
—— at Frame 34	7	6		
—— at Frame 35	5	9		
—— at Frame 36	4	2		
—— at Frame 37	2	8		
—— at Frame 38	1	5		
Post is 10 inches; the half is	0	5		
Sum	36	10		
Multiply by distance betw. Ordinates	2	8¾		
Product; or Area abaft Frame 32	100	6¼	100	6¼
			2100	1
Half Area of Rudder and Post			5	6
			2105	7
Multiply by				2
Whole Area of the Third Water Line from Dead-flat aft			4211	2

Fourth Water Line abaft ⊕.

	ft.	inc.
The Half Breadth at ⊕ is 20.1; of which one half is	10	0½
—— at Frame (5) is	20	1
—— at Frame 4	20	1
—— at Frame 8	20	0
—— at Frame 12	19	7½
—— at Frame 16	18	11
—— at Frame 20	17	7
—— at Frame 24	15	2
—— at Frame 28	10	10
—— at Frame 32 is 5.10; of which one half is	2	11
	155	3
Multiply by distance between the Frames	10	11
Product; or Area to Frame 32	1694	9¾

Area of the Part abaft Frame 32.

	ft.	inc.		
The Half Breadth at Frame 32 is 5.10; of which one half is	2	11		
—— at Frame 33 is	4	7		
—— at Frame 34	3	9		
—— at Frame 35	2	10		
—— at Frame 36	2	1		
—— at Frame 37	1	7		
—— at Frame 38	0	11		
Post is 9 inches; the half is	0	4½		
Sum	19	0½		
Multiply by distance betw. Ordinates	2	8¾		
	51	11½	51	11½
			1746	9¼
Half Area of Rudder and Post			5	0
			1751	9¼
Multiply by				2
Whole Area of the Fourth Water Line from Dead-flat aft			3503	6½

Areas of the Water Lines from Dead-flat aft.

Fifth Water Line abaft ⊕.

	ft.	inc.
The Half Breadth at ⊕ is 17.2 ; of which one half is	8	7
——— at Frame (5) is	17	2
——— at Frame 4	17	2
——— at Frame 8	16	10
——— at Frame 12	16	3
——— at Frame 16	15	2
——— at Frame 20	12	8
——— at Frame 24	8	6
——— at Frame 28	5	2
——— at Frame 32 is 2.8; of which one half is	1	4
Sum ...	118	10
Multiply by distance between the Frames	10	11
Product ; or Area to Frame 32	1297	3

Area of the Part abaft Frame 32.

	ft.	inc.		
The Half Breadth at Frame 32 is 2.8 ; of which one half is	1	4		
——— at Frame 33 is	2	4		
——— at Frame 34	1	11		
——— at Frame 35	1	6		
——— at Frame 36	1	2		
——— at Frame 37	1	0		
——— at Frame 38	0	9		
Post is 9 inches; the half is	0	4½		
Sum ...	10	4½		
Multiply by distance betw. Ordinates	2	8¼		
Product; or Area abaft Frame 32 ...	28	3¾	28	3¾
			1325	6¾
Half Area of Rudder and Post			4	6½
			1330	1¼
Multiply by				2
Whole Area of the Fifth Water Line from Dead-flat aft			2660	2½

Results, &c.

			ft.	inc.
Half of the Area of the Load Water Line			2659	10
Whole Area of the Second Water Line			4876	5
Whole Area of the Third Water Line			4211	2
Whole Area of the Fourth Water Line			3503	6½
Half Area of the Lower Water Line			1330	1¼
Sum ...			16581	0¾
Multiply by the distance between the Water Lines			4	1
Product, in cubic feet, between the Lower and Load Water Lines			67706	0
Area of the Lower Water Line	2660	2½		
Area of upper side of keel	184	6		
Sum ...	2844	8½		
One half is	1422	4¼		
Multiply by distance between Lower Water Line and Keel	4	1		
Cubic feet contained between Lower Water Line and Keel	5807	11¼	5807	11¼
Cubic feet of the keel, lower part of the rudder, and false keel			415	1½
Cubic feet abaft the Midship Frame under water, when loaded			73929	0¾

2. To find the Areas of the Water Lines from Dead-flat forward.

Upper or Load Water Line afore ⊕.

The Halfbreadth at ⊕ is 24.10; of which		*ft.*	*inc.*
one half is ...		12	5
——— at Frame D is		24	10
——— at Frame H		24	7
——— at Frame M		24	0
——— at Frame Q is 21.10; of which			
one half is		10	11
Sum ...		96	9
Multiply by distance between the Frames ...		10	11
Product or Area to Frame Q		1056	$2\frac{1}{4}$

Area of the Part afore Frame Q.

	ft.	*inc.*		
Halfbreadth that Frame Q is 21.10; of which one half is	10	11		
——— at Frame R is	20	11		
——— at Frame S	19	8		
——— at Frame T	18	$0\frac{1}{2}$		
——— at Frame U	15	11		
——— at Frame W	12	10		
——— at Frame X	8	9		
Stem is 0.9; the half is	0	$4\frac{1}{2}$		
Sum ...	107	5		
Multiply by dist. betw. Ordinates ...	2	$8\frac{3}{4}$		
Product, or Area afore Frame Q ...	293	$1\frac{3}{4}$	293	$1\frac{3}{4}$
			1349	4
Half Area of Stem and Knee			4	0
			1353	4
Multiply by ...				2
Whole Area of the Load Water Line from Dead-flat forward			2706	8

Second Water Line afore ⊕.

The Half breadth at ⊕ is 24.0; of which	*ft.*	*inc.*
one half is	12	0
——— at Frame D is	23	10
——— at Frame H	23	7
——— at Frame M	22	8
——— at Frame Q is 20.2		
of which one half is	10	1
Sum ...	92	2
Multiply by distance between the Frames	10	11
Product or Area to Frame Q	1006	$1\frac{3}{4}$

Area of the Part afore Frame Q.

	ft.	*inc.*		
The Half breadth at Frame Q is 20.2; of which one half is	10	1		
——— at Frame R is	18	10		
——— at Frame S	17	4		
——— at Frame T	15	$3\frac{1}{2}$		
——— at Frame U	12	6		
——— at Frame W	9	2		
——— at Frame X	5	1		
Stem is 0.9; the half is	0	$4\frac{1}{2}$		
Sum ...	88	8		
Multiply by distance betw. Ordinates	2	$8\frac{3}{4}$		
Product; or Area afore Frame Q ...	241	$11\frac{3}{4}$	241	$11\frac{3}{4}$
			1248	$1\frac{1}{2}$
Half Area of Stem and Knee			3	0
			1251	$1\frac{1}{2}$
Multiply by ...				2
Whole Area of the Second Water Line from Dead-flat forward			2502	3

Areas of the Water Lines from Dead-flat forward.

Third Water Line afore ⊕.

	ft.	inc.
The Half breadth at ⊕ is 22.2; of which one half is	11	1
——— at Frame D is	22	1
——— at Frame H	21	7
——— at Frame M	20	3
——— at Frame Q is 16. 8; of which one half is	8	4
Sum ...	83	4
Multiply by distance between the Frames ...	10	11
Product or Area to Frame Q	909	$8\frac{3}{4}$

Area of the Part afore Frame Q.

	ft.	inc.		
The Half breadth at Frame Q is 16.8; of which one half is	8	4		
——— at Frame R is	15	2		
——— at Frame S	13	$4\frac{1}{2}$		
——— at Frame T	11	0		
——— at Frame U	8	3		
——— at Frame W	4	11		
——— at Frame X is 0.9; the half is	0	$4\frac{1}{2}$		
Sum ...	61	5		
Multiply by distance betw. Ordinates	2	$8\frac{3}{4}$		
Product or Area afore Frame Q	167	$7\frac{1}{4}$	167	$7\frac{1}{4}$
			1077	4
Half Area of Stem and Knee			2	0
			1079	4
Multiply by ...				2
Whole Area of the Third Water Line from Dead-flat forward			2158	8

Fourth Water Line afore ⊕.

	ft.	inc.
The Half breadth at ⊕ is 20 feet 1 inch; of which one half is	10	$0\frac{1}{2}$
——— at Frame D is	19	10
——— at Frame H	19	$1\frac{1}{2}$
——— at Frame M	16	10
——— at Frame Q is 12.0; of which one half is	6	0
Sum ...	71	10
Multiply by distance between the Frames ...	10	11
Product or Area to Frame Q	784	$2\frac{1}{4}$

Area of the Part afore Frame Q.

	ft.	inc.		
The Half breadth at Frame Q is 12 ft. of which one half is	6	0		
——— at Frame R is	10	3		
——— at Frame S	8	$4\frac{1}{2}$		
——— at Frame T	6	0		
——— at Frame U	3	6		
——— at Frame W is 0. 9; the half is	0	$4\frac{1}{2}$		
Sum ...	34	6		
Multiply by distance betw. Ordinates	2	$8\frac{3}{4}$		
Product or Area afore Frame Q	94	$1\frac{3}{4}$	94	$1\frac{3}{4}$
			878	$4\frac{1}{4}$
Half Area of Stem and Knee			2	10
			881	$2\frac{1}{4}$
Multiply by ...				2
Whole Area of the Fourth Water Line, from Dead-flat forward			1762	$4\frac{1}{2}$

Areas of the Water Lines from Dead-flat forward, &c.

Fifth Water Line afore ⊕.

	ft.	inc.
The Half breadth at ⊕ is 17.2; of which one half is	8	7
——— at Frame D is	16	8
——— at Frame H	14	11
——— at Frame M	11	4
——— at Frame Q is 6.0; of which one half is	3	0
Sum ...	54	6
Multiply by distance between the Frames ...	10	11
Product or Area to Frame Q	594	11½

Area of the Part afore Frame Q.

	ft.	inc.	ft.	inc.
The Half breadth at Frame Q is 6.0; of which one half is	3	0		
——— at Frame R is	4	6½		
——— at Frame S	2	10		
——— at Frame T is 0.9; the half is	0	4½		
Sum ...	10	9		
Multiply by distance betw. Ordinates	2	8¾		
Product; or Area afore Frame Q ...	29	4	29	4
			624	3½
Half Area of Stem and Knee			4	10½
			629	2
Multiply by ...				2
Whole Area of the Fifth or Lower Water Line, from Dead-flat forward			1258	4

Results, &c.

	ft.	inc.	ft.	inc.
Half the Area of the Load Water Line			1353	4
Whole Area of the Second Water Line			2502	3
Whole Area of the Third Water Line			2158	8
Whole Area of the Fourth Water Line			1762	4½
Half Area of the Lower Water Line			629	2
			8405	9½
Multiply by the distance between the Water Lines			4	1
Product in cubic feet between the Lower and Load Water Lines			34323	7¾
Area of the Lower Water Line	1258	4		
Area of upper side of keel	84	0		
Sum ...	1342	4		
One half is ...	671	2		
Multiply by distance between Lower Water Line and Keel	4	1		
Cubic feet contained between Lower Water Line and Keel	2740	7	2740	7
Cubic feet displaced by the Keel, False Keel and Gripe			183	11¼
Cubic feet afore the Midship Frame under water, when loaded			37248	2

TOTALS.

	ft.	inc.
Cubic feet abaft the midship frame under water when loaded	73929	0¾
Cubic feet afore the midship frame under water when loaded	37248	2
Total number of cubic feet under water when loaded	111177	2¾
Multiplied by the weight of a cubic foot of salt water, which is	64⅜	lbs.

Produces the weight of the whole ship with every thing on board = 3195 tons 240 lbs. or 7157040 lbs.

According to the preceding calculation, the displacement agrees with the estimated weight of the whole ship; by which we find that the load water line in the draught is properly placed, and agreeable to the weight of the ship before found. In like manner may, therefore, the weight of any other ship be found: and, by reducing the displacement of the bottom into cubic feet, we may always ascertain if the load water line in the draught be properly placed.

If the load water line be found correct, it still remains to find whether the body be constructed suitably thereto; that is to say, whether the ship will be in her natural position when brought down agreeably to that line. For this purpose, erect a perpendicular twenty-seven feet abaft dead flat, which will be in the middle between the foremost and after perpendiculars, and the place where the centre of gravity should fall, in order that the ship may float on an even keel. Then calculate the displacement of that part of the bottom between the middle perpendicular and dead flat, as presently shewn, which we shall find to be 21305 feet $0\frac{3}{4}$ inches; and, adding the sum to the number of cubic feet afore dead-flat, we shall have the displacement of the fore part of the bottom. By deducting the sum from the number of cubic feet abaft dead-flat, we shall have the displacement of the aft part of the bottom, and may then examine the difference, if any, thus:

Half Breadths of the water lines abaft dead-flat, to be multiplied by the distance from to the middle perpendicular.

	Load Wat. L.	Sec. W. L.	Third W. L.	Fourth W. L.	Lower W. L.
	ft. inc.	*ft. inc.*	*ft. inc.*	*ft. inc.*	*ft. inc.*
Half Breadth	24 10	24 0	22 2	20 1	17 2
Multiply by Distance	27 0	27 0	27 0	27 0	27 0
Half Area	670 6	648	598 6	542 3	463 6
		2	2	2	
Area		1296	1197 0	1084 6	

	ft. inc.
Now the Half Area of the Load Water Line, as above, is	670 6
Whole Area of the Second Water Line	1296 0
Whole Area of the Third Water Line	1197 0
Whole Area of the Fourth Water Line	1084 6
Half Area of the Lower Water Line	463 6
	4711 6
Multiply by the distance between the Water Lines	4 1
Solid Content between the Load and Lower Water Lines abaft ⊕ to the middle perpendicular	19238 $7\frac{1}{2}$

	ft.	inc.
Again, Half the Area of the Lower Water Line	463	6
Half the Area of the upper side of keel	20	3
Sum	483	9
Multiply by distance between Lower Water Line and Keel	4	1
Solid Content	1975	$3\frac{3}{4}$

	ft.	inc.
And, Area of the Keel	40	6
Multiplied by depth and false keel	2	3
Solid Content	91	$1\frac{1}{2}$

	ft.	inc.
Solid Content betweenthe Load and Lower Water Lines abaft ⊕ to the middle perpendicular	19238	$7\frac{1}{2}$
Solid Content between the Lower Water Line and upper side of the keel abaft ⊕ to the middle perpendicular	1975	$3\frac{3}{4}$
Solid Content of the Keel and False Keel	91	$1\frac{1}{2}$
Sum ...	21305	$0\frac{3}{4}$
Add, number of cubic feet in the bottom displaced afore dead-flat	37248	2
Solid Contents displaced by the fore part of the bottom	58553	$2\frac{3}{4}$
Number of cubic feet in the bottom displaced abaft dead-flat	73929	$0\frac{3}{4}$
From which deduct the solid content between the middle perpendicular and dead-flat	21305	$0\frac{3}{4}$
Solid Contents of the aft part of the bottom	52624	0
———— fore part of ditto	58553	$2\frac{3}{4}$
Difference: or fore part more than the aft part	5929	$2\frac{3}{4}$

By the result of this calculation it appears, that the after part of the bottom is too lean; its contents being 5929 feet $2\frac{3}{4}$ inc. less than the fore part. The fore part is, therefore, proportionably too full; and, as half the difference is 2964 feet 7 inches, we must swell out the after part until it has accumulated 2964 feet 7 inches, and reduce the fore part until it has lost the same quantity. This done, the bottom will be constructed suitably to the ship's sailing on an even keel at her load draught of water.

We have already shewn the reasons given for constructing all large ships so as to sail on an even keel; it would not, however, be improper for them to be so built as to sail somewhat by the stern; although some have even proposed that vessels drawing more water abaft than afore should have a part cut off from the lower side of the keel, in the direction of a line drawn from the middle of the ship's length, at the lower part of the keel, to the stern-post, at two feet from the bottom of the keel: and, that the part of the keel and dead wood thus taken off from the aft part should be placed under the fore part, with that part forward which was aft before, so as to make the lower side of the keel horizontal. Common practice, and the general experience of seamen, seems, however, to assure us, that vessels drawing most water by the stern, when loaded, sail better than those which, under similar circumstances, have their keels truly horizontal. For, a vessel being impelled through the water by the action of the wind on her sails, and these being elevated to a considerable height above her hull, it follows that the pressure of the sails tends to depress the bow and raise the stern; the keel will then, of course, be depressed below a horizontal forward, which is against velocity; and it would be highly improper, in the opinion of many, to load a vessel, contrary to her construction, so as to draw more water abaft than afore. It may therefore, perhaps, be best, in order that a ship shall sail on an even keel when loaded, to construct her so as to draw rather more water abaft than afore.

§ 3. OF FINDING THE TONNAGE OR BURTHEN OF SHIPS, &c.

HAVING shewn, in the preceding rules and examples, the method of ascertaining a ship's weight, or displacement, when brought down to her load draught of water, we shall now, both upon the same and other principles, shew how her true burthen or tonnage may be calculated.

By the *Tonnage* is generally understood the burthen of a vessel as computed by an established but very defective rule, which we shall presently give, producing what is usually called *Builder's Tonnage*, in contra-distinction to the true tonnage.

By this rule, all vessels, whether their bodies be extremely full or extremely sharp, will appear to be precisely of the same burthen or capacity, if the length of keel and extreme breadth be similar. Thus, the sharpest cutter will seem to carry as much as the fullest merchant-ship of the same length and breadth extreme. This method is, of course, exceedingly detrimental to that principle which promises velocity; as the ship which is narrowest above, and widest and deepest below, will measure least in proportion to her real capacity; the very reverse of which is necessary for fast sailing.

We shall, therefore, calculate the real burthen or tonnage of the eighty-gun ship from the weight, and also lay down several calculations of the real burthen of some other bodies which differ in shape and dimensions; together with their tonnage, as cast by the common rule; in order to shew the great disadvantages of the present very erroneous method of computing the burthen of ships.

It must certainly appear reasonable that the real burthen or tonnage will be that weight which is required to bring the ship down to the load-water line from the light-water mark; and, it consequently follows, that, if we construct a ship, the body of which shall be rather full, and so formed as to draw but little water; and, if we construct another, of the same dimensions, with a body much sharper than the former, and so that it shall sink deeper in the water; in this case, the load-water lines being at the same height, by reason of the dimensions being the same, it will require a greater weight to bring the full ship down to her load-water line than it will the other, as there will be a greater volume of water to displace between the light and load water lines in the one than in the other; and, consequently, the ship which requires the most weight to bring her down to the load-water line will be of the greatest burthen in proportion to the difference of the weights so required.

In order, therefore, to ascertain the true burthen of a ship, we have only to find the place of the light-water line, and thence calculate the number of cubic feet below the line of floatation. The product, deducted from the number of cubic feet contained at the load-draught, will shew the real capacity by which the tonnage may be computed: and, if the difference be multiplied by the weight of a cubic foot of sea water, $64\frac{3}{8}$ lbs., the product, divided by 2240 (the number of lbs. in a ton), will give the true burthen in tons.

Or, in other words, by deducting the weight of the ship at her light-water mark from her weight when brought down to the load-water mark, the remainder will be the tonnage.

THE GENERAL RULES OBSERVED FOR MEASURING THE TONNAGE OF SHIPS, IN THE KING'S AND MERCHANTS' SERVICE.

1. Let fall a perpendicular from the fore side of the stem, at the height of the hawse-holes*, and another perpendicular from the back of the main post, at the height of the wing transom.

2. From the length between these perpendiculars, deduct three-fifths of the extreme breadth †, and likewise as many $2\frac{1}{2}$ inches as the wing transom is high from the upper edge of the keel, and the remainder is accounted the length of the keel for tonnage.

Then multiply the length of the keel for tonnage by the extreme breadth, and that product by half the extreme breadth; then, dividing by 94, the quotient will be the burthen in what is denominated Builder's Tonnage.

Or, Multiply the length of the keel for tonnage by the square of the extreme breadth, and divide the product by 188, the quotient will be the burthen in tons.

The Rule made use of by the Officers of the Customs, for the computation of Tonnage Duties, for all vessels, excepting coal-vessels, is established by the act of parliament 13 Geo. III. c. 74, as follows:

The length shall be taken on a straight line along the rabbet of the keel, from the back of the main stern-post to a perpendicular line from the fore part of the main stem under the bowsprit; from which, subtracting three-fifths of the breadth, the remainder must be esteemed the just length of the keel to find the tonnage; and the breadth shall be taken from the outside of the outside plank in the broadest place in the ship, be it either above or below the main wales, exclusive of all manner of doubling planks that may be wrought upon the sides of the ship; then,

* In the merchant-service, this perpendicular is let fall from the fore side of the stem, at the height of the wing transom, by reason of the hawse-holes being generally so very high, and their stems also having a great rake forward.

† By the extreme breadth is meant the breadth taken from timber to timber outside, with the thickness of the bottom on each side added; or, which is the same thing, the thickness of the bottom on each side added to the moulded breadth.

multiplying the length of the keel by the breadth so taken, and that product by half the breadth, and dividing the whole by 94, the quotient will be deemed the true contents of the tonnage.

ESTIMATE, shewing the REAL BURTHEN of an EIGHTY-GUN SHIP.

	No. of Tons.	lbs.
The weight of the ship at her launching draught of water	1385	433
The weight of the furniture	195	720
The weight of the ship at her light-water mark	1580	1153
The weight of the ship at the load-water mark	3195	240
From which deduct the weight at the light-water mark	1580	1153
Real Burthen	1614	1328

CALCULATION OF THE BURTHEN ACCORDING TO THE COMMON RULE.

	Ft.	In.	Ft.	In.
Length from the fore side of the stem, at the height of the hawse-holes, to the aft side of the main post, at the height of the wing transom			185	6
Three-fifths of the extreme breadth is	29	9½		
The height of the wing transom is 28 feet 4 inches, which produces for every 2½ inches	6	8½		
Total	36	6	36	6
Length of the keel for tonnage			149	0
Multiplied by the extreme breadth			49	8
Product			7400	4
Multiplied by half the extreme breadth			24	10
Divided by			94)183774	11
Burthen in Tons according to the common rule			$1955\frac{5}{94}$	

	Tons.	lbs.
Tonnage as customary	1955	119
Real burthen	1614	1328
Difference	340	1031

From this we may observe, that the eighty-gun ship will not carry the tonnage she is rated for by 340 tons, 1031 lbs.; and by this we discern the impropriety of such a rule being made general, it being only applicable to particular bodies. It will also be found by experiment, that all ships of war carry less tonnage than they are rated for by the common rule, and merchant ships carry a great deal more, by reason of the former bodies being very sharp, and the latter ones very full. The body of the eighty-gun ship, widely as it differs, comes nearer to the tonnage cast by the common rule than smaller ships; in which the proportionate difference is considerably more. We will now give another example in the

CALCULATION of the TONNAGE of the AUDACIOUS, of SEVENTY-FOUR GUNS.

		Ft.	In.
Length on the gun deck		168	0
Keel for tonnage		138	0
Breadth extreme		46	9
Depth in hold		19	9
Launching draught of water	Afore	12	0
	Abaft	17	4
Load draught of water	Afore	20	6
	Abaft	21	6

	Tons.	lbs.
The weight of the ship at her launching draught of water	1509	678
The weight of the furniture	120	1500
Weight of the ship at her light-water mark	1629	2178
The weight of the ship at her load-water mark	2776	498
From which deduct the weight at the light-water mark	1629	2178
Real burthen	1146	560

BY THE COMMON RULE.

Keel for tonnage 138 feet, multiplied by extreme breadth 46 feet 9 inches, is equal to 6451 feet 6 inches, which being multiplied by half the extreme breadth 23 feet $4\frac{1}{2}$ inches, is equal to 150803 feet, and divided by 94, the quotient is $1604\frac{27}{94}$, the burthen in tons.

	Tons.	lbs.
Tonnage by the common rule as customary	1604	643
Real burthen	1146	560
Difference	458	83

By which it appears, that this ship does not carry the tonnage she is rated for by 458 tons 83 lbs., and so likewise will it be found in all similar bodies; and, the sharper the body the greater difference there will be in the tonnage. The bodies which increase upon the tonnage cast by the common rule, are very full, such as merchant ships in general: we shall therefore calculate the tonnage of a merchant ship both ways, in order that the student may see the great inaccuracy of the rule with respect to those bodies, as well as to ships of war, by which he will be further convinced of the errors that he is liable to fall into by adhering to the common rule.

CALCULATIONS of the TONNAGE of an EAST-INDIAMAN.

		Ft.	In.
Suppose,—Length between the perpendiculars forward and aft		132	8
Keel for tonnage		105	0
Breadth extreme		38	0
Depth in hold		16	0
Launching draught of water	Afore	7	10
	Abaft	11	10
Load draught of water	Afore	19	8
	Abaft	20	8

	Tons.	lbs.
The weight of the ship at her launching draught of water	602	2116
The weight of the furniture	50	124
Weight of the ship at her light-water mark	653	
The weight of the ship at her load-water mark	1637	1670
From which deduct the weight at her light-water mark	653	
Real burthen	984	1670

BY THE COMMON RULE.

Keel for tonnage 105 feet, multiplied by the extreme breadth 38 feet, is equal to 3990 feet, which being multiplied by half the extreme breadth 19 feet, is equal to 75810 feet, and divided by 94, the quotient is 806 $\frac{46}{94}$, the burthen in tons.

	Tons.	lbs.
Real burthen	984	1670
Tonnage by the common rule as customary	806	1096
Difference	178	574

We now find that the East-Indiaman will carry 178 tons 574 lbs. *more* than she is rated for by the common rule, which it plainly appears is in consequence of her body being formed so very full; and we shall now, in order to shew the great contrast there is between full and sharp bodies, with respect to their tonnage, calculate the burthen of a cutter, which will more strikingly shew the impropriety of the erroneous method practised for casting a ship's tonnage.

CALCULATION of the TONNAGE of a CUTTER.

		Ft.	In.
Suppose,—Length of the keel for tonnage		58	0
Breadth extreme		29	0
Launching draught of water	Afore	5	10
	Abaft	9	8
Load draught of water	Afore	9	0
	Abaft	12	10

	Tons.	lbs.
The weight of the cutter at her launching	147	640
The weight of the furniture	9	199
Weight of the cutter at her light-water mark	156	839
The weight of the cutter at her load-water mark	266	1970
From which deduct the weight at her light-water mark	156	839
Real burthen	110	1131

BY THE COMMON RULE.

Keel for tonnage 58 feet, multiplied by the extreme breadth 29 feet, is equal to 1682 feet, which, being multiplied by half the extreme breadth 14 feet 6 inches, is equal to 24389 feet, and divided by 94, the quotient is 259 $\frac{43}{94}$, the burthen in tons.

	Tons.	lbs.
Tonnage as customary	259	1024
Real burthen	110	1131
Difference	148	2133

Hence it is obvious that no dependance can be placed on the common rules for the ascertainment of the true tonnage of vessels. Indeed we neither have, nor expect to have, any rule that shall be quite exact: because, the tonnage depends not only upon the cubical dimensions of the ship's bottom, but also on the scantling of her whole frame, and, in short, on the weight of every thing which properly makes a part of the ship. We must therefore be contented with a rule that approximates nearly to the truth; and such are those which follow:

RULES BY MR. PARKYNS, LATE OF HIS MAJESTY'S YARD, CHATHAM.

Rule I. *For sharp Ships, particularly those of the Royal Navy.*

1. Take the length on the gun-deck, from the rabbet of the stem to the rabbet of the stern-post, or between the perpendiculars. Then take $\frac{23}{24}$ of this length, and call it the *keel for tonnage.*

2. To the extreme breadth add the length of the gun-deck, or length between the perpendiculars; then take $\frac{1}{23}$ of this sum, and call it the *depth for tonnage.*

3. Set up this depth from the limber strake; and, at that height, take a breadth also from out to outside of the plank at dead-flat, and another breadth between that and the limber strake; add together the extreme breadth and these two breadths; take one-third of the sum, and call it the *breadth for tonnage.*

4. Multiply the length for tonnage by the depth for tonnage, and the product by the breadth for tonnage, and divide by 49. The quotient will be the burthen in tons nearly.

The following trials have been made to prove the accuracy of this rule:

		Tonnage by the King's or common rule.	*Tonnage by Mr. Parkyns's rule.*	*Tonnage actually received on board.*
Victory, of	100 guns	2162	1839	1840
London	90	1845	1575	1677
Arrogant	74	1614	1308	1314
Diadem	64	1369	1141	965
Adamant	50	1044	870	886
Dolphin	44	879	737	758
Amphion	32	667	554	549
Daphne	20	429	329	374

Rule II. *For Ships of Burthen, or Commercial Ships, in general.*

1. Take the length of the lower deck, from the rabbet of the stem to the rabbet of the stern-post; then take $\frac{31}{32}$ of this length, and call it the *keel for tonnage.*

2. To the extreme breadth add the length of the lower deck; then take $\frac{3}{55}$ of the sum, and call it the *depth for tonnage.*

3. Set up this depth from the limber strake; and, at that height, take a breadth also from out to outside of the plank at dead-flat. Take another at two-thirds of this height, and another

at one-third of the height. Add the extreme breadth and these three breadths together, and take one-fourth of the sum for the *breadth for tonnage.*

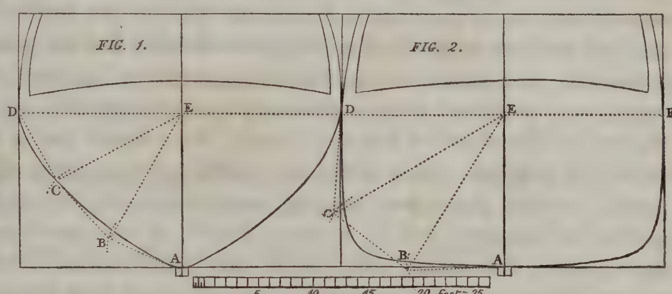
4. Multiply the length for tonnage by the depth for tonnage, and the product by the breadth for tonnage, and divide by 36.6666 or $36\frac{2}{3}$, and the quotient will be the burthen in tons.

The following trials, among many others, shew that this rule does not deviate far from truth.

	Tonnage by the King's or common rule.	Tonnage by Mr. Parkyns's rule.	Tons actually received on board.
GRANBY, East-India ship	786	1179	1179
NORTHINGTON, East-India ship . .	676	1053	1064
UNION, a collier	193	266	289
FRIENDS' GOODWILL, a collier . . .	182	254	277

RULE BY A MERCHANT-BUILDER.

The following is another method, which has been proposed by a merchant-builder, of long experience and high respectability, as much more correct than the common rule for the computation of a ship's tonnage. In explaining it, we shall take an example from two vessels, exactly of the same length, breadth, and depth, but different in bulk, one being very sharp and the other very flat, as exhibited in the annexed figures.



RULE.—Take the perpendicular height from the lower part of the rabbet of the keel to the height of the load-water line DF; which we will assume as 13 feet 11 inches. Then take the extreme breadth from out to outside of the plank of the bottom, at that height, which we shall call 29 feet 5 inches; set up the first height, 13 feet 11 inches, forward on the stem and aft on the stern-post, and take the length at that height from the fore part of the rabbet on the stem to the aft part of the rabbet on the stern-post, or 105 feet 6 inches; from which subtract $2\frac{1}{2}$ inches to a foot, for the rake of the stern-post, for 13 feet 11 inches, which is 2 feet 11 inches; and three-fifths of 29 feet 5 inches, the extreme breadth, for the rake of the stem = 17 feet 7 inches; add both together = 20 feet 6 inches, and subtract it from 105 feet 6 inches, leaves for the length of keel for tonnage 85 feet.

Take the length of the curve AD from the lower part of the rabbet of the keel to the load-water line (suppose 21 feet 3 inches), and, dividing it into three equal parts, take one of those parts (7 feet 1 inch) in your compasses; then, placing one foot at A, the middle line of the keel at the garboard strake, sweep a small arch B. Again, setting one foot at D, sweep a similar arch at C. Between these arches lay off, in a straight line, one-third of the length AD, viz. the distance BC, 7 feet 1 inch. Then will AB, BC, and CD, be respectively equal. Now draw the lines CE, BE, which will form three triangles: calculate the superficial feet in each of these triangles, by multiplying the base by half the perpendicular (47 feet 9 inches, 44 feet 3 inches, and 46 feet $1\frac{1}{2}$ inch); add the results together, and the sum will be found = 138 feet $1\frac{1}{2}$ inch. Multiply this sum by 2 (it being only the superficial feet of one half of the section), and the product will be 276 feet 3 inches, the superficial content of the area of the vessel to the height of the load-water line; then multiply 276 feet 3 inches by 85 feet, the length of keel, and the product will be = 23481; dividing this by $64\frac{3}{8}$, the weight of a cubic foot of sea water, we gain $364\frac{4}{5}$ for the tonnage or burthen of a vessel of the description of figure 1, which is a very sharp one.

Again, let us proceed to figure 2, in the same manner.—Distance between A and D, on the curve of the body, 26 feet; one third of which is 8 feet 8 inches. Form three triangles, as above, making the shortest side of each 8 feet 8 inches; then compute their superficial area, viz. 66 feet 5.4 inches, 71 feet 6 inches, and 64 feet 3.4 inches; which, added together, make 202 feet $2\frac{2}{3}$ inches; this, multiplied by 2, produces 404 feet $5\frac{1}{3}$ inches; the product again by 85, the length of the keel, = 34375 feet, which, divided by $64\frac{3}{8}$, gives 534, very nearly, for the tons burthen of a vessel of the description of figure 2, which is a very flat one.

These vessels, by the established method, both measure alike, 390 tons; and it is an experienced fact, that the one will not carry so much, and the other a great deal more.

The present method is not given as perfectly exact, but as much nearer the real burthen of vessels than the old one: nor is it probable that any one method or common rule will be found that will measure all descriptions of vessels exactly; and the tonnage of vessels depends, in some degree, on the weight and scantling of the wood they are built of. For instance, an Archangel vessel, built of fir, will carry considerably more than another, of the same plan in every respect, built at the Havannah of live oak. Again, some vessels have a very fine body aft and forward; others are very full. It is sufficient, therefore, to say, that all the essential dimensions, the length, breadth, depth, and capacity, are considered by this method as equal operators in computing the tonnage; and as, in many vessels, of the same length and breadth, some are two and three feet higher than others of the same measurement according to the established method, they would by this be considerably augmented; and, with regard to vessels of the same length, breadth, and depth, but of different capacity, the two sections above delineated fully shew that there must be a considerable difference in their burthen; and that there is, there are few vessels but what sufficiently demonstrate.

The method itself is very plain and obvious: nothing more is required to be done in dock, or on the ground, or wherever the vessel is, but to take the length, breadth, the perpendicular height of the load-water line, and the girt from the middle line of the keel at the lower part of the garboard strake to the load-water line; all the rest may be done in ten minutes on paper, as we have shewn.

THE GENERAL RULE FOR CALCULATING THE LOADING OF COLLIERS is as follows:

From the length of the keel subtract six or seven feet for the dead stowage fore and aft; multiply the remainder by the breadth of the frame, and that product by the depth of water the ship draws when loaded; divide this by 96, and you will have the number of London chaldrons the ship will carry.

We shall now subjoin the following

EXPERIMENTAL METHOD OF FINDING THE TONNAGE OF A SHIP.

Construct an accurate model, agreeably to the draught of the proposed ship, to a scale of about one fourth of an inch to a foot, and let the light and load water lines be marked on it. Then put the model in water, and load it until the surface of the water is exactly at the light-water line; and let it be suspended until the water drains off, and then weighed. Now, since the weights of similar bodies are in the triplicate ratio, or as the cubes, of their homologous dimensions, the weight of the ship when light is, therefore, equal to the product of the cube of the number of times the ship exceeds the model by the weight of the model, which is to be reduced to tons. Hence, if the model is constructed to a quarter of an inch scale, multiply the weight of the model by the cube of 48* or 110592, which will give the weight of the ship. If the multiplier be ounces, the product will be ounces; if pounds, it will be pounds; and is to be reduced to tons accordingly.

EXAMPLE.—Suppose the weight of a model to be 30 lbs. or 480 oz.

The cube of 48	110592
Multiplied by	30 lbs. or 480 oz.
Produces	3317760 lbs. = 1481 tons 320 lbs.

The operation may be considerably abridged by logarithms, thus:

If the weight be expressed in ounces, then, to the constant logarithm 0.4893557 add the logarithm of the weight of the model in ounces; and the sum will be the logarithm of the weight of the ship in tons.

EXAMPLE.—To the constant logarithm	0.4893557†
Add the logarithm of 480 (ounces) ...	2.6812412
Produces the logarithm of 1481.2 nearly;	3.1705969

Again, the model is to be loaded until the surface of the water coincides with the load-water line. Now, the model being weighed, the weight of the ship is to be found by the preceding rule: then, the difference between the weights of the ship when light and loaded is the tonnage required.

METHOD OF CONSTRUCTING A SCALE OF SOLIDITY,

By which may be ascertained the quantity of water displaced at any given draught, and the weight required to bring the ship down to any draught of water proposed.

In order to construct this scale for any ship, it is requisite, in the first instance, to calculate the quantity of water displaced by the bottom below each water line and by the keel, in the

* One fourth of an inch being equal to $\frac{1}{48}$ of a foot.

† The constant logarithm is found by subtracting the logarithm of 35840, the number of ounces in a ton, from the logarithm of the cube of 48, or 110592.

manner that we have heretofore shewn for the eighty-gun ship; for which ship, as the areas of her several water lines are already computed, a scale of solidity may be readily constructed as follows.

Construct a scale of equal parts, to represent tons, as the scale so marked in Plate H.; and another to represent feet and inches, as that below it. The larger these scales the more exact will be the performance.

Draw the line AH, limited at A, but continued at pleasure towards H. At A draw the perpendicular AG. Then set off AB, equal to the depth of the keel, two feet three inches; and at B draw a line, parallel to AH, which will represent the upper edge of the keel. Next set off the distance, four feet one inch, from the upper edge of the keel, for the fifth or lower water line C; and, in like manner, lay off the other water lines D, E, F, G, as shewn on the plate.

Now form a table, similar to that annexed, from the calculations already made.

The manner of filling up the first column of this table requires little explanation; since it is obtained merely by first inserting the depth of the keel and false keel, and adding, successively, the distance of each water line, as shewn.

The second column is obtained, by first taking, from the foregoing calculations, the cubical contents of the keel, both abaft and afore ⊕. These will be found, when added, to be 599 and a fraction, as shewn in the table.

In the same manner, add together the cubical feet, aft and forward, contained between the fifth or lower water line and keel; add the sum to the former, and the whole will be 9147 feet 7 inches, the displacement at C or the fifth water line.

Again, find the mean area, or half the sum, of the fifth and fourth water lines (4592.2$\frac{3}{4}$); multiply it by the distance between the water lines (4 feet 1 inch), and add the product to the former. The sum will be 27899.2, the displacement at D, or the fourth water line.

In like manner, find the mean area of the fourth and third water lines, and multiply it by the distance between. Add the product to the former, and it will produce 51655.6, the displacement at E, or the third water line. Thus proceed with the rest.

The third column is to be filled up by multiplying each line of the second column by the weight of a cubical foot of sea water (64$\frac{3}{8}$ lbs.), and dividing the product by the number of pounds in a ton; which will, of course, give the weight in tons and pounds, as in the Table.

Water Lines, &c.	Height.		Water displaced in			
	Ft.	*In.*	*Cubic Feet.*		*Tons.*	*lbs.*
Keel and False Keel	2	3 = B	599	0$\frac{3}{4}$	...17	522
Between the Keel and the Fifth Water Line	4	1......	 8548	6$\frac{1}{4}$	.245	1911
Sum ...	6	4 = C	 9147	7	.262	1995
Between the Fifth and Fourth Water Lines	4	1......	...18751	7	.538	1908
Sum ...	10	5 = D	...27899	2	.801	1730
Between the Fourth and Third Water Lines ...	4	1......	...23756	4	.660	1859
Sum ...	14	6 = E	...51655	6	1484	1162
Between the Third and Second Water Lines ...	4	1......	...28069	10$\frac{1}{4}$	.806	1550
Sum ...	18	7 = F	...79725	4$\frac{1}{4}$	2291	480
Between the Second and Load Water Lines ...	4	1......	...31451	10$\frac{1}{2}$	.903	1994
Sum ...	22	8 = G	111177	2$\frac{3}{4}$	3195	240

Now set off the tonnages upon their corresponding water lines, &c. from the above table, thus: Upon the line B, representing the upper edge of the keel, set off from the perpendicular AG 17 tons 522 lbs. taken from the scale of tons, equal to Bb. Upon the line C, or lower water line, set off 262 tons 1995 lbs. equal to Cc. Upon the line D, or fourth water line, set off 801 tons 1730 lbs. equal to Dd. In like manner, set off the other tonnages upon their corresponding water lines. Then, through the points A b c d e f g draw the curve Ag, which will represent the solidity of displacement at any given height.

For example; the weight of the hull, when launched, is, by the estimate, 1385 tons 433 lbs. Take, therefore, this quantity from the scale of tons, and set it off from the perpendicular line AG along the line AH, or base; whence raise the perpendicular IK to intersect the curve of displacement. The depth we find by the scale to be 14 feet 3 inches, nearly, which will be the ship's launching draught of water in the middle of her length. By calculating the displacement of 1385 tons 433 lbs. the launching draught of water will be found to be 11 feet 9 inches forward and 16 feet 9 inches abaft, or nearly so (as may be seen by the ticked line in the sheer-draught), the mean of which is 14 feet 3 inches also.

Again, we find, by the estimate, that the ship, with her furniture, displaces 1580 tons 1153 lbs. at her light-water mark. Take 1580 tons 1153 lbs. from the scale of tons, set it off as before, and raise the perpendicular LM to intersect the curve of displacement.

Then raise a perpendicular from the line AH to intersect the load-water line at g, and it will be the utmost limit of the quantity of water, expressed in tons, displaced by the bottom of the ship when she is brought down to her load-water line. But, to complete the figure, let MH be divided into a scale of tons, taken from the tonnage scale below, beginning at H; and, likewise, Lg beginning at L.

Now it is evident, from what has been already said, that, if the number of cubic feet of water which the ship displaces when light, or, which is the same, the number of cubic feet below the light-water line, be subtracted from the number of cubic feet contained in the bottom below the load-water line, the quotient will be the real burthen or tonnage.—Any other case to which this scale may be applied is obvious.—Let it be required to find the number of cubic feet displaced when the draught of water is 16 feet 6 inches, and the number of additional tons required to bring her down to her load-water line:

Take 16 feet 6 inches from the scale of feet, and set it off upon the perpendiculars AG, and Hg, above the line AH, and draw an horizontal line through those spots, intersecting the curve of displacement at O. Take the distance NO, in the horizontal line, and apply it on the tonnage scale; it will measure 1843 tons 399 lbs. the displacement answerable to that draught of water: and, the measurement OP, applied to the tonnage scale, will give 1351 tons 2081 lbs. the additional weight necessary to bring her down to the load-water line.

Let us now suppose the ship, at her light draught of water, to receive on board a weight of 262 tons 1443 lbs. Take in the compasses 262 tons 1443 lbs. and set it off on the lines AH and Gg, to the right of the line LM. Through those points the line OO will cut the scale of tons on MH at 1351 tons 2081 lbs. the additional weight required to load the ship to the load water line. It will likewise cut the scale on the line Lg at 262 tons 1443 lbs. the weight received on board; and the perpendicular will shew the draught with that additional weight

If the draught of water be required, corresponding to any given weight intended to be put on board, it may be known as follows:

Find the given number of tons, suppose 1075, in the scale on the line L g, through which draw a line perpendicular to the base A H; then, at the intersection of this perpendicular with the curve of displacement, as at S, draw an horizontal line. Now the perpendicular distance between the base line A H and intersection at S being applied on the scale of feet, will give 20 feet 6 inches, the draught of water required.

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§ 4. METHODS OF FINDING THE CENTRES OF DISPLACEMENT AND GRAVITY.

Having now sufficiently treated upon the displacement of a vessel, it remains to point out the means of finding the centre of displacement and gravity.

The centre of gravity of a ship, supposed homogeneous, and floating at rest in the water, without inclination, is in a vertical section, passing through the keel, and dividing the ship into two equal and similar parts, at a certain distance from the stern and altitude above the keel.

In order to ascertain the centre of displacement, or centre of gravity of the immersed part of a ship's bottom, in a state of rest, we begin by determining the centre of gravity of a horizontal section of the ship at the load water line: and, as the two sides are equal and similar, the middle line may be considered as the axis of the equilibrium, in which the centre of gravity of that surface is to be found.

Secondly, as the sides of that surface are formed by curves, the breadths must be severally taken by ordinates placed equally distant from, and so near to, each other, that the curve intercepted between every two of them may be considered as a straight line; which will be sufficiently exact for practice.

Thirdly, These ordinates will divide the surface into a number of parallelograms at the spaces between the frames 32, 28, 24, 20, &c. which may be considered as such, on account of their being placed so near to each other. Now, it is plain, that the centre of gravity of the parallelogram between timber (5) and timber D, (see the Draught, plate 1,) supposing the whole breadth of the plan, would intersect the middle line at $\oplus$, and it will be so with the rest. Therefore, the centres of gravity of all the parallelograms will form a system distributed on the middle line.

And, fourthly, to find the centre of gravity of the system, in respect to the aftside of the rudder, which is assumed for the first term of the momenta; we must multiply the surface of each parallelogram by the distance of its centre of gravity from the aft side of the rudder: and thus having the sum of all the momenta, we may divide that sum by the sum of the surfaces of all the parallelograms, or by the whole area of the load water line, and the quotient will be the centre of gravity from the aftside of the rudder, the axis of the momenta.

But we may abbreviate the operation, having previously obtained the area of the whole surface made by the load water line, by the method which follows.

First, Divide the whole length into several equal parts, as at the timbers 32, 28, &c.

But, as this has already been done, for the purpose of finding the displacement, proceed—Secondly, to measure all the ordinates and add them together, excepting the first and last, of which, as before, only one half must be taken.

Thirdly, Multiply the sum by the distance betwixt the ordinates, and the product will be the area of each section.

The second particular to be obtained is the sum of the momenta of all the elementary parts of the surface; by multiplying the length of each ordinate into its distance from the axis of the momenta or first ordinate; then take the sum of all these products, and, by multiplying this sum by the distance between the ordinates will be produced the sum of all the momenta of the elementary parts of the surface; which, divided by the sum of the ordinates, will quote the distance of the centre of gravity of the whole surface from the axis of the momenta.

Lastly, the areas of the several planes, or surfaces, and their momenta being found, divide the one by the other, and the quotient will be the distance of the centre of gravity of the whole section from the aftside of the rudder.

OPERATION FOR THE PLANE OF THE LOAD WATER LINE.

To find the Centre of Gravity of the Plane between 32 and Q, from 32 its first Ordinate.

	Ordin.		Feet.	Inc.		Distant from 32.		Products.	
Half of	32	is	20	9					
Whole of	28	...	45	0	multiplied by	1	=	45	0
	24	...	47	4	....	2	=	94	8
	20	...	48	6	....	3	=	145	6
	16	...	49	0	....	4	=	196	0
	12	...	49	3	....	5	=	246	3
	8	...	49	5	....	6	=	296	6
	4	...	49	8	....	7	=	347	8
	(5)	...	49	8	....	8	=	397	4
	⊕	...	49	8	....	9	=	447	0
	D	...	49	8	....	10	=	496	8
	H	...	49	2	....	11	=	540	10
	M	...	48	0	....	12	=	576	0
Half of	Q	...	21	10	....	13	=	283	10
	Sum	...	626	11			Sum ...	4113	3

Multiply by distance between the Ordinates 10 11

Divide by sum of Ordinates 626.11 44902 $11\frac{3}{4}$

Centre of Gravity .... 71 $7\frac{3}{4}$

Distance of ordinate 32 from the aftside of the rudder .... (add) 25 $4\frac{1}{3}$

Centre of Gravity from aftside of the rudder 96 $11\frac{7}{8}$

To find the Centre of Gravity of the Plane abaft 32, from 39 its first Ordinate.

	Ordin.		Feet.	Inc.		Distant from 39.		Products.	
Half of	39	is	0	11					
Whole of	38	...	15	4	multiplied by	1	=	15	4
	37	...	26	8	....	2	=	53	4
	36	...	32	10	....	3	=	98	6
	35	...	36	4	....	4	=	145	4
	34	...	38	6	....	5	=	192	6
	33	...	40	2	....	6	=	241	0
Half of	32	...	20	9	....	7	=	145	3
	Sum	...	211	6			Sum ...	891	3

Multiply by distance between the Ordinates 2 $8\frac{3}{4}$

Divide by sum of Ordinates, 211 6 .... 2432 4

Centre of Gravity 11 6

Distance of Ordinate 39 from the aftside of the rudder .... (add) 6 4

Centre of Gravity from aftside of the rudder 17 10

The distance of the centre of gravity of the section of the rudder and stern post from the aft part of the rudder is .... 2 $10\frac{1}{2}$

*** *This is found as the centre of gravity of any other regular figure, by the intersection of its diagonals. See the Hafl Breadth Plan of the* 80 *gun ship.*

To find the Centre of Gravity of the Plane afore Q, from Q its first Ordinate.

			Feet.	Inc.		Distant from Q.		Products.	
Half of	Q	is	21	10					
Whole of	R	...	41	10	multiplied by	1	=	41	10
	S	...	39	4	....	2	=	78	8
	T	...	36	1	....	3	=	108	3
	U	...	31	10	....	4	=	127	4
	W	...	25	8	....	5	=	128	4
	X	...	17	6	....	6	=	105	0
	Y	...	7	0	....	7	=	49	0
Half of Stem		...	0	10	....	8	=	6	8
	Sum	...	221	11			Sum ...	645	1

Multiply by distance between the Ordinates 2 $8\frac{3}{4}$

Divide by sum of Ordinates 221.11 ... 1760 $11\frac{1}{4}$

Centre of Gravity .... 7 $11\frac{1}{4}$

Distance of ordinate Q from the aftside of the rudder ....(add) 167 $3\frac{1}{2}$

Centre of Gravity from aftside of the rudder 175 $2\frac{3}{4}$

Centre of Gravity of the knee before the Stem 0 7

Distance of the centre of gravity of the section of the knee from the aftside of the rudder 189 $8\frac{1}{2}$

Areas of the several Planes and their Momenta.

*** *The areas are found by multiplying the sum of the ordinates by the distance between; as, for the midship plane,* 626 *ft.* 11 *inc. by* 10 *ft.* 11 *inc. which produces* 6843 *ft.* 10 *inc.*

Areas.—Of the midship plane, 6843 ft. 10 inc.

6843 10 × by 97 $11\frac{7}{8}$ its momentum, = 663780 $6\frac{1}{2}$

Area of the after plane 577 $2\frac{5}{8}$

577 $2\frac{5}{8}$ × by 17 10 its momentum, = 10293 5

Area of the fore plane 605 6

605 6 × by 175 $2\frac{3}{4}$ its momentum = 106073 $7\frac{1}{2}$

Area of the rudder 11 $7\frac{1}{4}$

11 $7\frac{1}{4}$ × by 2 $10\frac{1}{2}$ its momentum = 33 $4\frac{3}{8}$

Area of the knee 2 $0\frac{1}{5}$

2 $0\frac{1}{5}$ × by 189 $8\frac{1}{2}$ its momentum = 381 $4\frac{1}{4}$

8040 2 Sum. Sum of momenta 780561 $4\frac{1}{5}$

Now 780561 $4\frac{1}{5}$ divided by 8040 2 gives 97 feet $0\frac{3}{4}$ inches, the distance of the centre of gravity of the whole section of the load water line from the aftside of the rudder.

OPERATION FOR THE PLANE OF THE SECOND WATER LINE.

To find the Centre of Gravity of the Plane between 32 and Q, from 32 its first Ordinate.

	Ordin.	Feet.	Inc.		Distant from 32.		Products.	
Half of	32 is	17	4					
Whole of	28 ...	41	3	multiplied by	1	=	41	3
	24 ...	44	6	....	2	=	89	0
	20 ...	46	3	....	3	=	138	9
	16 ...	47	1	....	4	=	188	4
	12 ...	47	7	....	5	=	237	11
	8 ...	47	10	....	6	=	287	0
	4 ...	48	0	....	7	=	336	0
	(5) ...	48	0	....	8	=	384	0
	⊕ ...	48	0	....	9	=	432	0
	D ...	47	8	....	10	=	476	8
	H ...	47	2	....	11	=	518	10
	M ...	45	4	....	12	=	544	0
Half of	Q ...	20	2	....	13	=	262	2
	Sum ...	596	2			Sum ...	3935	11

Multiply by distance between the Ordinates	10	11
Divide by sum of Ordinates 596 2	42967	1
Centre of Gravity	72	$0\frac{1}{2}$
Distance of Ordinate 32 from the aftside of the rudder ....(add)	25	$2\frac{1}{2}$
Centre of Gravity from aftside of the rudder	97	3

To find the Centre of Gravity of the Plane abaft 32, from 39 its first Ordinate.

	Ordin.	Feet.	Inc.				Products.	
Half of	39 is	0	$10\frac{1}{2}$					
Whole of	38 ...	5	2	multiplied by	1	=	5	2
	37 ...	11	8	....	2	=	23	4
	36 ...	17	8	....	3	=	53	0
	35 ...	23	4	....	4	=	93	4
	34 ...	27	10	....	5	=	139	2
	33 ...	31	8	....	6	=	190	0
Half of	32 ...	17	4	....	7	=	121	4
	Sum ...	135	$6\frac{1}{2}$			Sum ...	625	4

Multiply by distance between the Ordinates	2	$8\frac{3}{4}$
Divide by sum of Ordinates, 135 $6\frac{1}{2}$	1706	$7\frac{1}{2}$
Centre of Gravity	12	7
Distance of ordinate 39 from the aftside of the rudder ....(add)	6	2
Centre of Gravity from aftside of the rudder	18	9
Distance of the Centre of Gravity of the section of the rudder and stern post from the aft-part of the rudder	2	$10\frac{1}{2}$

To find the Centre of Gravity of the Plane before Q from Q its first Ordinate.

	Ordin.	Feet.	Inc.		Distant from Q.		Products.	
Half of	Q is	20	2					
Whole of	R ...	37	8	multiplied by	1	=	37	8
	S ...	34	8	....	2	=	69	4
	T ...	30	7	....	3	=	91	9
	U ...	25	0	....	4	=	100	0
	W ...	18	4	....	5	=	91	8
	X ...	10	2	....	6	=	61	0
Half of	Y ...	0	9	....	7	=	5	3
	Sum ...	177	4			Sum ...	456	8

Multiply by distance between the Ordinates	2	$8\frac{3}{4}$
Divide by sum of Ordinates, 177.4* ...	1246	3
Centre of Gravity	7	$0\frac{1}{4}$
Distance of Ordinate Q from aftside of the rudder ....(add)	167	$1\frac{3}{4}$
Centre of Gravity from aftside of the rudder	174	2
Centre of Gravity of the knee before Y is	1	0
Distance of the Centre of Gravity of the section of the knee from the aftside of the rudder	187	2

Areas of the several Planes and their Momenta.

Areas.—Of the midship plane, 6508 ft. 2 inc.

6508 2 × by 97 3, its momentum =	632919	$2\frac{1}{2}$
Area of the after plane 369 11		
369 11 × by 18 9 its momentum =	6935	$11\frac{1}{4}$
Area of the fore plane 483 $11\frac{3}{4}$		
483 $11\frac{3}{4}$ × by 174 2 its momentum =	84292	7
Area of the rudder and post 10 $9\frac{1}{4}$		
10 $9\frac{1}{4}$ × by 2 $10\frac{1}{2}$ its momentum =	30	$11\frac{5}{8}$
Area of the knee 3 0		
3 0 × by 187 2 its momentum =	561	6
7375 10 Sum — Sum of Momenta	724740	$2\frac{3}{8}$

Now 724740 $2\frac{3}{8}$ divided by 7375 10 gives 98 feet $3\frac{1}{8}$ inches, the distance of the centre of gravity of the whole section of the second water line from the aftside of the rudder.

OPERATION FOR THE PLANE OF THE THIRD WATER LINE.

To find the Centre of Gravity of the Plane before Q, from 32 its first Ordinate.

	Ordin.	Feet. Inc.		Distant from 32.	Products.
Half of	32 is	11 2			
Whole of	28 ...	33 0	multiplied by	1 =	33 0
	24 ...	38 10	....	2 =	77 8
	20 ...	41 8	....	3 =	125 0
	16 ...	43 0	....	4 =	172 0
	12 ...	43 8	....	5 =	218 4
	8 ...	44 2	....	6 =	265 0
	4 ...	44 4	....	7 =	310 4
	(5) ...	44 4	....	8 =	354 8
	⊕ ...	44 4	....	9 =	399 0
	D ...	44 2	....	10 =	441 8
	H ...	43 2	....	11 =	474 10
	M ...	40 6	....	12 =	486 0
Half of	Q ...	16 8	....	13 =	216 8
	Sum ...	533 0		Sum	3574 2

Multiply by distance between the Ordinates 10 11

Divide by sum of Ordinates, 533 0 ...... 39018 0

Centre of Gravity 73 2½
Distance of Ordinate 32 from the aftside of the rudder .... (*add*) 25 2

Centre of Gravity from aftside of the rudder 98 4½

To find the Centre of Gravity of the Plane abaft 32, from 39 its first Ordinate.

	Ordin.	Feet. Inc.		Distant from 32.	Products.
Half of	39 is	0 10			
Whole of	38 ...	2 11	multiplied by	1 =	2 11
	37 ...	5 4	....	2 =	10 8
	36 ...	8 4	....	3 =	25 0
	35 ...	11 6	....	4 =	46 0
	34 ...	15 0	....	5 =	75 0
	33 ...	18 8	....	6 =	112 0
Half of	32 ...	11 2	....	7 =	78 2
	Sum ...	73 9		Sum	349 9

Multiply by distance between the Ordinates 2 8¾

Divide by sum of Ordinates 73 9 .... 954 6

Centre of Gravity 12 11¼
Distance of Ordinate 39 from the aftside of the rudder .... (*add*) 6 1½

Centre of Gravity from aftside of the rudder 19 0¾

Distance of the Centre of Gravity of the section of the rudder and stern post from the aftside of the rudder is 2 10½

To find the Centre of Gravity of the Plane between 32 and Q, from Q its first Ordinate.

	Ordin.	Feet. Inc.		Distant from Q.	Products.
Half of	Q is	16 8			
Whole of	R ...	30 4	multiplied by	1 =	30 4
	S ...	26 9	....	2 =	53 6
	T ...	22 0	....	3 =	66 0
	U ...	16 6	....	4 =	66 0
	W ...	9 10	....	5 =	49 2
Half of	X ...	0 9	....	6 =	4 6
	Sum ...	122 10		Sum ...	269 6

Multiply by distance between the Ordinates 2 8¾

Divide by sum of the Ordinates 122 10 .... 735 6

Centre of Gravity 5 11¾
Distance of Ordinate Q from aftside of the rudder .... (*add*) 167 1¼

Centre of Gravity from aftside of the rudder 173 1

Centre of Gravity of the Knee before X is 1 7
Distance of the Centre of Gravity of the section of the Knee and Stern before the aftside of the rudder 185 0¼

Areas of the several Planes and their Momenta.

Areas.—Of the midship plane 5818 7
5818 7 × by 98 4½, its momentum = 572403 1
Area of the after plane 201 3¼
201 3¼ × by 19 0¾, its momentum = 3836 8
Area of the fore plane 341 5¾
341 5¾ × by 173 1, its momentum = 59104 4½
Area of the rudder and post 10 1
10 1 × by 2 10½, its momentum = 28 11⅞
Area of the Stem and Knee, 4 4½
4 4½ × by 185 0¼, its momentum = 809 5⅝

6375 9½ Sum. Sum of Momenta 636182 7

Now 636182 7 divided by 6375 9½ gives 99 feet 9½ inches, the distance of the Centre of Gravity of the whole section of the third water line from the aftside of the rudder.

OPERATION FOR THE PLANE OF THE FOURTH WATER LINE.

To find the Centre of Gravity of the Plane between 32 and Q, from 32 its first Ordinate.

	Ordin.	feet.	inc.		Distant from 32.		Products.	
Half of	32	is 5	10					
Whole of	28	... 21	8	multiplied by	1	=	21	8
	24	... 30	4	....	2	=	60	8
	20	... 35	2	....	3	=	105	6
	16	... 37	10	....	4	=	151	4
	12	... 39	3	....	5	=	196	3
	8	... 40	0	....	6	=	240	0
	4	... 40	2	....	7	=	281	2
	(5)	... 40	2	....	8	=	321	4
	⊕	... 40	2	....	9	=	361	6
	D	... 39	8	....	10	=	396	8
	H	... 38	3	....	11	=	420	9
	M	... 33	8	....	12	=	404	0
Half of	Q	... 12	0	....	13	=	156	0

Sum ... 454 2 Sum ... 3116 10

Multiply by distance between the Ordinates 10 11

Divide by sum of Ordinates, 454 2 ...... 34025 5

Centre of Gravity 74 11

Distance of Ordinate 32 from aftside of the rudder .... *(add)* 25 1

Centre of Gravity from aftside of the rudder 100 0

To find the Centre of Gravity of the Plane abaft 32, from 39 its first Ordinate.

	Ordin.	feet.	inc.		Distant from 32.		Products.	
Half of	39	is 0	9½					
Whole of	38	... 1	10	multiplied by	1	=	1	10
	37	... 3	2	....	2	=	6	4
	36	... 4	2	....	3	=	12	6
	35	... 5	8	....	4	=	22	8
	34	... 7	6	....	5	=	37	6
	33	... 14	2	....	6	=	85	0
Half of	32	... 5	10	....	7	=	40	10

Sum ... 43 1½ Sum ... 206 8

Multiply by distance between the Ordinates 2 8¾

Divide by sum of Ordinates, 43 1½ 563 11

Centre of Gravity 13 0⅞

Distance of Ordinate 39 from the aftside of the rudder .... *(add)* 6 1

Centre of Gravity from aftside of the rudder 19 1⅞

Distance of the Centre of Gravity of the section of the rudder and stern post from the aftside of the rudder is 2 10½

To find the Centre of Gravity of the Plane before Q, from Q its first Ordinate.

	Ordin.	feet.	inc.		Distant from 32.		Products.	
Half of	Q	is 12	0					
Whole of	R	... 20	6	multiplied by	1	=	20	6
	S	... 16	9	....	2	=	33	6
	T	... 12	0	....	3	=	36	0
	U	... 7	0	....	4	=	28	0
Half of	W	... 0	9	....	5	=	3	9

Sum ... 69 0 Sum ... 121 9

Multiply by distance between the Ordinates 2 8¾

Divide by sum of Ordinates, 69 0 .... 332 3

Centre of Gravity 4 9⅓

Distance of Ordinate Q before the aftside of the rudder .... *(add)* 167 0¾

Centre of Gravity from aftside of the rudder 171 10¼

Centre of Gravity of the Knee before W is 2 0

Distance of the Centre of Gravity of the section of the Stem and Knee before the aftside of the rudder is 182 7¾

Areas of the several Planes and their Momenta.

Areas.—Of the midship plane 4958 0

4958 0 × by 100 0, its momentum = 495800 0

Area of the after plane 117 8⅜

117 8⅜ × by 19 1⅞, its momentum = 2255 6

Area of the fore plane 188 3¾

188 3¾ × by 171 10¼, its momentum = 32362 3½

Area of rudder and post 9 4

9 4 × by 2 10½, its momentum = 26 10

Area of stem and knee 5 10½

5 10½ × by 182 7¾, its momentum = 1073 0½

5279 2⅝ Sum. Sum of Momenta 531517 8

Now 531517 8 divided by 5279 2⅝ gives 100 feet 8¼ inches, the distance of the Centre of Gravity of the whole section of the fourth water line from the aft side of the rudder.

OPERATION FOR THE PLANE OF THE FIFTH WATER LINE.

To find the Centre of Gravity of the Plane between 32 and Q, from 32 its first Ordinate.

	Ordin.	feet. inc.		Distant from 32.	Products.
Half of	32	is 2 8			
Whole of	28	... 10 4	multiplied by	1 =	10 4
	24	... 17 0	....	2 =	34 0
	20	... 25 4	....	3 =	76 0
	16	... 30 4	....	4 =	121 4
	12	... 32 6	....	5 =	162 6
	8	... 33 8	....	6 =	202 0
	4	... 34 4	....	7 =	240 4
	(5)	... 34 4	....	8 =	274 8
	⊕	... 34 4	....	9 =	309 0
	D	... 33 4	....	10 =	333 4
	H	... 29 10	....	11 =	328 2
	M	... 22 8	....	12 =	272 0
Half of	Q	... 6 0	....	13 =	78 0
	Sum ...	346 8		Sum ...	2441 8
Multiply by distance between the Ordinates					10 11
Divide by sum of Ordinates, 346 8					26655 0
Centre of Gravity					76 10½
Distance of Ordinate 32 from the aftside of the rudder .... (add)					25 0
Centre of Gravity from aftside of the rudder					101 10½

To find the Centre of Gravity of the Plane abaft 32 from 39 its first Ordinate.

	Ordin.	feet. inc.		Distant from 39.	Products.
Half of	39	is 0 9			
Whole of	38	... 1 6	multiplied by	1 =	1 6
	37	... 2 0	....	2 =	4 0
	36	... 2 4	....	3 =	7 0
	35	... 3 0	....	4 =	12 0
	34	... 3 10	....	5 =	19 2
	33	... 4 8	....	6 =	28 0
Half of	32	... 2 8	....	7 =	18 8
	Sum ...	20 9		Sum ...	90 4
Multiply by distance between the Ordinates					2 8¾
Divide by sum of Ordinates, 20 9					246 6
Centre of Gravity					11 10½
Distance of Ordinate 39 from the aftside of the rudder .... (add)					6 0
Centre of Gravity from aftside of the rudder					17 10½
Distance of the Centre of Gravity of the section of the rudder and stern post from the aftside of the rudder					2 9½

To find the Centre of Gravity of the Plane before Q, from Q its first Ordinate.

	Ordin.	feet. inc.		Distant from 32.	Products.
Half of	Q	is 6 0			
Whole of	R	... 9 1	multiplied by	1 =	9 1
	S	... 5 8	....	2 =	11 4
Half of	T	... 0 9	....	3 =	2 3
	Sum ...	21 6		Sum ...	22 8
Multiply by distance between the Ordinates					2 8¾
Divide by sum of Ordinates, 21 6					61 10
Centre of Gravity					2 10½
Distance of Ordinate Q from the aftside of the rudder .... (add)					166 11¾
Centre of Gravity from aftside of the rudder					169 10¼
Centre of Gravity of the Knee before T is ...					3 8
Distance of the Centre of Gravity of the section of the stem and knee from the aftside of the rudder					184 2¾

Areas of the several Planes and their Momenta.

Areas.—Of the midship plane 3784 6¼	
3784 6¼ × by 101 10½, its momentum =	385548 0¾
Area of the after plane 56 7½	
56 7½ × by 17 10½, its momentum =	1012 2
Area of the fore plane 58 8⅛	
58 8⅛ × by 169 10¼, its momentum =	9966 6½
Area of post and rudder 9 4½	
9 4½ × by 2 9⅞ its momentum =	26 5½
Area of stem and knee 11 0	
11 0 × by 184 2¾, its momentum =	2026 6¼
3920 2⅜ Sum. Sum of Momenta	398579 9

Now 398579 9 divided by 3920 2⅜ gives 101 feet 8 inches, the distance of the Centre of Gravity of the whole section of the fifth water line from the aftside of the rudder.

OPERATION FOR THE PLANE OF THE KEEL, &c.

To find the Centre of Gravity for the Plane of the Keel.

	ft. inc.
The length on the upper side or plane of the keel from the aftside of the rudder is	179 0
Multiplied by its breadth	1 6
Produces area of the plane	268 6
The distance of its Centre of Gravity from the aftside of the rudder, being equal to half of its length, is	89 6
Now 268 6 × 89 6 is equal to the momentum, or	24030 9

The Centres of Gravity of the six planes having been found, the distance of the Centre of Gravity of the whole bottom of the ship from the aftside of the rudder is obtained as follows :

From the principles already explained, the distance of the Centre of Gravity of the bottom from the aftside of the rudder is equal to the sum of the momenta of an infinite number of horizontal planes, divided by the sum of these planes ; or, which is the same, by the solidity of the bottom. As, however, we have no more than six planes, we must conceive their momenta as the ordinates of a curve, whose distances may be the same as that of the horizontal planes.

Now the sum of these ordinates, (or planes) except the first and last, of which take but the half, being multiplied by their distance, gives the surface of the curve, of which any ordinate whatever represents the momentum of the horizontal plane at the same height as these ordinates ; and the whole surface will represent the sum of the momenta of all the horizontal planes.

	Planes.		*Momenta.*	
Half of the First	4020	1	 390280	8
All the Second	7375	10	 724740	$2\frac{3}{8}$
Third	6375	$9\frac{1}{2}$	 636182	7
Fourth	5279	$2\frac{5}{8}$	 531517	8
Fifth	3920	$2\frac{3}{8}$	 398579	9
Half of the Sixth	134	3	 12015	$4\frac{1}{2}$
Sum	27105	$4\frac{1}{2}$	2693316	2

Now 2693316 2 divided by 27105 $4\frac{1}{2}$ gives 99 feet $4\frac{3}{8}$ inches the distance of the centre of gravity of the bottom of the ship from the aftside of the rudder.

THE HEIGHT of the Centre of Gravity of the bottom may be determined upon the same principles, thus :

To half of the first and last horizontal planes add all the intermediate planes, and multiply them progressively as before, taking the upper side of the keel for the axis of the momenta; then, that sum being multiplied by the distance between the planes, and divided by the sum of the planes, taking half of the first and last, gives the height of the centre of gravity of the bottom above the keel.

	Planes.			*Dist. fr. the 6th.*		*Products.*	
Half of the Sixth ...	134	3					
All the Fifth ...	3920	$2\frac{3}{8}$	× by	1	=	3920	$2\frac{3}{8}$
Fourth ...	5279	$2\frac{5}{8}$	....	2	=	10558	$5\frac{1}{4}$
Third ...	6375	$9\frac{1}{2}$	....	3	=	19127	$4\frac{1}{2}$
Second ...	7375	10	....	4	=	29503	4
Half of the First ...	4020	1	....	5	=	20100	5
Sum ...	27105	$4\frac{1}{2}$				83209	$9\frac{1}{8}$

Now 83209 $9\frac{1}{8}$ divided by 27105 $4\frac{1}{2}$ gives 3 feet and $0\frac{7}{8}$ of an inch ; which, multiplied by 4 feet 1 inch, the distance between the horizontal sections, gives 12 feet $6\frac{1}{2}$ inches, the height of the centre of gravity of the bottom of the ship from the lower edge of the keel.

The distance of the centre of gravity of the bottom of the ship from the aftside of the rudder, and its height above the lower edge of the keel, being found, the ship supposed in an upright position, the centre of gravity will necessarily be in the perpendicular longitudinal section supposed to divide the ship in two equal and similar parts ; the position of this centre is therefore determined by the ticked line abaft timber 4 in the sheer draught. See the plate.

In the preceding calculations we have supposed the hull to be composed of an homogeneous matter, all parts of which in bulk will be of equal weight; now, this is a case which seldom happens in a ship, but the calculations will, nevertheless, be useful, as all ships of the same rate have the different weights placed nearly similar with respect to their lengths. We may, therefore, find the centre of gravity, or of displacement, as above; and, by comparing the result with the centre of gravity of a ship which is known by experience to have all the good qualities that can be expected, shall then be enabled to discover if the centre of gravity of the intended ship be properly placed.

We shall now conclude this section by describing a mechanical way of finding the centre of gravity; as it is a method that may be easily executed and that may be satisfactory to those persons, in particular, who are not disposed to give themselves the trouble of finding it by the calculations.

A MECHANICAL METHOD OF FINDING THE CENTRE OF GRAVITY IN A SHIP.

This method of finding the centre of gravity is exactly similar to the experimental method heretofore described for finding the tonnage, by the construction of a model to a scale of one quarter of an inch to a foot of the corresponding parts on the ship; and care must be taken to provide the wood as light as possible. The same model will, of course, answer both purposes.

The model being accurately constructed, may be suspended by a thin line or silk, in different positions, until it points out the centre of gravity; which will be found when the block hangs in a state of equilibrium: this practice is, doubtless, very simple, but it will be found very convenient.

Many useful discoveries may be made by models or blocks, and with as great certainty as by the nicest calculations; for it must be allowed, that, in calculating from a draught by a quarter scale, it will be liable to some inaccuracies which cannot be obviated in practice, by reason of various little alterations which may be made in laying the ship down in the mould loft; consequently, the draught and the ship will in those points disagree. And likewise, upon strict examination, we shall be enabled to find, that there are very few ships that have both their sides exactly equal in every respect.

In order to prove our block, we may suspend it by a line fastened to a hook in any part of a straight line drawn from the middle line of the stem to that of the post; this hook may be moved forward and aft to different places in the middle line, and a weight may be suspended from the upper part of the middle line on the post; if the two sides be exactly of equal dimensions and homogene, they will then be of equal weight: a plane passing through these three lines, whatever part of the middle line the hook be in, will likewise pass through the middle line of the keel, stem, and post. Therefore, if our model stands this proof, it will be as true to work from as the nicest calculations.

The model being suspended by the hook, the lines hanging at the stem and post corresponding to their middle lines, and to that which suspends the block, we may hold a batten out of winding with the line that suspends it; and, with a pencil, draw a line upon it; a plane passing through this pencil line, at right angles to the keel, and passing likewise through the line that suspends the block, will likewise pass through the centre of gravity, which, therefore, must be somewhere in this plane. Again, move the hook to some other part in the middle line, and let the block be suspended from that point; draw also another pencil line, out of winding with this last line of suspension, and the intersection of the two lines will give the height of the centre of gravity above the keel, and likewise its distance from the post and stem; and, if the hook be moved to any other parts of the middle line, and a pencil line be drawn as before, it will likewise intersect in the same point; or, let there be ever so many points assumed in the middle line, and the block suspended by each, and pencil lines drawn, they will all intersect in the same point; and, as the centre of gravity will always be in that plane which passes through the middle line of the keel, stem, and post, it may with certainty be marked on the draught.

This will certainly require the utmost nicety; but, if well executed, will agree with that found by calculation, provided the dimensions be taken very exactly, and likewise from a true scale of equal parts.

Having now investigated the centre of gravity and displacement, so far as is consistent with our present purposes, and laid down all that is requisite to be attended to, in that respect, for the construction of a ship's body, we shall proceed, in the next section, to find the point of stability, or META-CENTRE.

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§ 5. OF THE DETERMINATION OF THE POINT OF STABILITY OR META-CENTRE.

WE have already shewn, in the third chapter of Book I. that the effort of the water's power to sustain a vessel in an upright position, passes through the centre of cavity, or centre of gravity of the displacement; and, that the direction of its effort is perpendicularly to the water's surface. Therefore, if a vessel is at rest and in smooth water, her centre of gravity is in the mean direction of the effort of the water which supports her. When the vessel is inclined, or *heels*, she should have a tendency, in herself, to regain her upright position; that is to say, her centre of gravity ought to be so situated, that the effort of the vessel's weight should concur with the effort of the water to right her.

This concurrence of efforts is what we have termed *stability* or stiffness, and the point of stability, or *meta-centre*, is that point, in the vertical section of her length, at the middle line, *under* which the centre of gravity of the vessel ought always to be, in order to prevent her oversetting.

TO FIND THE POINT OF STABILITY, OR META-CENTRE, OF THE EIGHTY-GUN SHIP, OR ANY OTHER VESSEL.

Let ABC *(figure 2. plate H.)* represent a thwartship section of the eighty-gun ship at the centre of gravity of displacement; D the centre of cavity or centre of displacement, and AB the load water line when the vessel is upright. Let EC, a perpendicular to the line of floatation, pass through the point D. As the result of the force of the water to support the vessel is found in the line EC, it necessarily follows that the centre of gravity of the vessel is also in the same line. See Proposition II. page 131.

Let us now imagine the vessel to receive a small inclination, say 10 degrees, without its augmenting or diminishing the displacement; let FG represent the line of floatation during this inclination: hence result two triangles, equal and similar; the one, HBG, above the water; and the other, HAF, under the water: let I and K be the centres of gravity of these triangles, and L the centre of cavity, or centre of displacement, when inclined. Trace from the point L the line L M perpendicular to the supposed line of inclination F G, and it will intersect the line CE in some point as N.

N is the point of stability, or the Meta-centre: for, if the centre of gravity be found below this point, the vessel will keep itself upright or tend to right itself. On the contrary, if above, it will overset, as shewn by Proposition IV. page 131.

Again, if the centre of gravity is at the same point with that of displacement D, then the weight of the vessel acts on all the distance LD, against the inclination.

The vessel, in its inclined state, would have the middle line CE removed to the line OP; then the line of support LQ traced upwards, perpendicularly, intersects the inclined line OP between P, the power applied, and centre of gravity L, and discovers the meta-centre of the inclination to be at R, according to the fourth proposition, page 131. But, it would be very singular that it should so happen that the centre of gravity of all the system, both the weight of the hull and the rigging and the other heterogeneous weights, more or less, as artillery, &c. with which the vessel may be loaded, should be found to be in the centre of gravity of displacement D. For, by calculation, we shall find it near the line of floatation in the 80 gun-ship, as in ships of war the centre of gravity can never be removed far from the line of floatation; and, could the centre of gravity be placed very low, it is not to be desired, because the further it is removed from the line of floatation, so much the more will the movements of the ship increase. We may therefore lay it down as an axiom, that a body put in motion turns round its centre of gravity as long as no foreign power prevents it. Then, the centre of gravity being at the load water line, the vertical CE is changed to the line ST by the inclination, and the meta-centre carried up to u in the line S T.

To ascertain the altitude or height of the meta-centre above the centre of gravity of the immersed part of the bottom, the section at the load water line must be divided by lines perpendicular to the middle line of this section into a sufficient number of equal parts, so that the portion of the curve contained between any two adjacent perpendiculars may be considered as a straight line. This having been already done to find the displacement, we take them thence. Then, the sum of the cubes of the half perpendiculars, or ordinates, is to be multiplied by the distance between them, and two-thirds of the product is to be divided by the immersed part of the bottom of the ship.

It is hence evident, that while the section at the water line is the same, and the volume of the immersed part of the bottom remains also the same, the altitude of the meta-centre will remain the same, whatever may be the figure of the bottom.

Names and lengths of the Ordinates at the Load Water Line, in feet and dec. parts.	*Cubes of the Ordinates.*	*Names and lengths of the Ordinates.*	*Cubes of the Ordinates.*	*Names and lengths of the Ordinates.*	*Cubes of the Ordinates.*
32 20.75	8934.17	33 20.08	8096. 38	R, 20.91	9142.44
28 22.50	11390.62	34 19.25	7133. 33	S, 19.66	7598.90
24 23.66	13244.76	35 18.16	5988. 91	T, 18.04	5870.97
20 24.25	14260.52	36 16.41	4419. 02	U, 15.91	4027.27
16 24.50	14706.12	37 13.33	2368. 59	W, 12.83	2111.93
12 24.62	14923.27	38 7.66	449. 45	X, 8.75	669.92
8 24.70	15069.22	39 0.91	0.754	Y, 2.58	17.17
4 24.83	15308.41	40 0.91	0.754	Z, 0.83	0.572
(5) 24.83	15308.41	41 0.91	0.754		
⊕ 24.83	15308.41	multiply by the		multiply by the	
D 24.83	15308.41	dist. betw. the	28457.942	dist. betw. the	29439.172
H 24.58	14850.66	Ordinates	2.729	Ordinates	2.729
M 24.00	13824.00				
Q 21.83	10403.06		77661.7237		
			80339.5003	................: Sum	80339.5003
Multiply by the dist.	192840.04				
betw. the Ordinates	10.91				
Sum	2103884.8364	....	2103884.8364		

2261886.0604 Sum of the Products.
2

3) 4523772.1208

feet inc.

Cubic feet of Salt water displaced 111177.2291) 1507924.0402 = 13 6¾

Remainder 62620.0619
Multiply by 12

75140.7428

Remainder 84367.3628
Multiply by 8

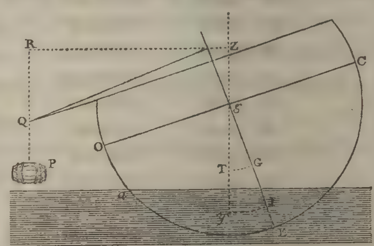
674938.9456

Gives 13 feet 6¾ inches, the height of the meta-centre above the centre of gravity of the immersed part of the bottom of the ship.

It may be advantageous, after a ship is built, rigged, and laden, to possess the means of being assured that the centre of gravity be properly situated with respect to the meta-centre; we therefore subjoin the following experimental method of making this determination.

Sometimes, in the course of a voyage, the positions of many things are greatly changed or varied. The consumption of ammunition and provisions in a long voyage is also very considerable; and it may be necessary to ascertain, at times, what changes thence result. This may be found by a simple experiment.

If we place a weight, P, on the outside of the ship, OEC, at the outer end Q of a spar, laid across the ship, this will make the ship incline to a certain point, at which time there will be an exact equilibrium betwixt the weight suspended without the ship, and the whole weight of the ship, on each side of the line YZ, in the direction of the vertical effort of the water. The common centre of gravity G, is in the same vertical with the meta-centre, when the ship is in an horizontal situation; and the more the ship inclines, the more will the centre of gravity G be removed from the line YZ, the vertical of the meta-centre, or line of support. It is plain, that GT, the distance from that line, is always in proportion to the sine of the inclination; at least, when the inclination is but small. Now, if that distance, and, likewise, the whole weight of the ship be known, we have also its momentum, or the relative force with which that weight acts, in endeavouring to right the ship, and bring her again into an horizontal situation; but, since both the situation, and likewise, the weight that produces the inclination, are known, we may thence know if the momentum of one be equal to that of the other, and thereby easily discover if the centre of gravity be in that very point we propose.



We cannot be too nice in taking the quantity of the angle of inclination, for the success of the whole experiment depends on this: to attain this, we may use a level line for the sensible horizon of the sea, or a plumb line fastened to the head of the mast, and take its distance from the foot of the mast, both when the ship is upright, and, likewise, when she heels: the plumb-line seems to be the most convenient, because we have thereby immediately the proportion in which the centre of gravity recedes from the vertical of the meta-centre, which will always be in proportion to the distance of the plumb-line from the foot of the mast. We must be very careful, during the whole time of the operation, to render all the circumstances absolutely the same, that we may be well assured the inclination is produced only by the weight applied to the outside of the ship: no doubt, this will require the assistance of many hands, to put every thing requisite in its proper place, but they must all withdraw, when the distance of the plumb-line and the other dimensions are measuring. The weight of two or three, or sometimes even ten, men need not be regarded; whereas the weight of the whole crew would produce a very sensible alteration; and, it is conceived, that the crew might be disposed to great advantage in the experiment, as they may be easily moved from one place to another.

We may, in this manner, find the centre of gravity of the ship, provided we only know the meta-centre; for, having the quantity of the weight that produces the inclination, and examining R Z, its distance from the meta-centre, or line of support, in which the effort of the water exerts itself, we have, also, its momentum, or its relative force, which is equal to the weight of the whole ship, since these two exactly balance one another; so that it is only dividing this momentum by the whole weight of the ship, and the quotient will give us the distance of the centre of gravity, G, from YZ, the line of support, or vertical of the meta-centre. If the weight that makes the ship incline be five tons, and its distance from YZ be 30 feet, its momentum will be expressed by 150, because $5\times30=150$; and, if this momentum be divided by 1800, which may be supposed the weight of the whole ship, we shall find that the distance of the centre of gravity from the vertical YZ is one inch. After this, it will be easy to discover how far the centre of gravity is below the meta-centre *g*; since there will always be the same proportion betwixt the distance of the plumb-line from the foot of the mast, and the height of the mast, that there is betwixt GT, one inch, the distance of the centre of gravity G, from YZ, the vertical of the meta-centre, and gG, the distance betwixt the meta-centre and the centre of gravity. If a plumb-line, of 50 feet long, is one inch distant from the foot of the mast, we have this proportion, as 1 : 50 :: 1 (inch, the distance of the centre of gravity from the meta-centre) : 50 inches, which makes G *g*, the distance of the centre of gravity below the meta-centre, 4 feet 2 inches.

We may remark, that, in order to determine this exactly, it is not necessary to know the *precise* point in which the meta-centre lies; it may be supposed in the middle of the breadth line O C on the upper deck.

The smaller the weight is that makes the ship heel, so much the greater must be its distance from the ship; however, an error of some inches, in the horizontal distance of the weight will be scarcely perceptible.

In fine, where neither the situation of the centre of gravity, nor of the meta-centre, is known, this experiment will, at least, have one considerable advantage, that thereby we may know if these two points are always situated in the same proportion with respect to one another. We may, by these means, be in condition to reap the profit of all experiments made in former voyages, and easily find the ship's best sailing trim, which the mariners call her *seat* in the water.

All ships have a scale of feet on their post and stem, to determine the draught of water afore and abaft: we may, by this scale, discover if the whole weight, and if the goods be stowed exactly in the same manner, with respect to the length of the ship, and likewise if the centre of gravity be properly situated in respect of fore and aft. But, though these be important particulars, yet these alone are not sufficient: for admitting we have all these, the centre of gravity may be either too high or too low; to ascertain which, we must have recourse to the preceding, or a similar, experiment.

CHAPTER III.

INSTRUCTIONS FOR DELINEATING THE SEVERAL DRAUGHTS AND PLANS OF A SHIP.

§ 1. GENERAL OBSERVATIONS ON THE PROPORTIONAL DIMENSIONS, &c. PREPARATORY TO THE CONSTRUCTION OF A DRAUGHT.

IN order to fix upon the proportions for a ship of any class, it will be necessary, in the first place, to determine on the length between the foremost and after perpendiculars; as, when that determination is once fixed, it becomes a standard whereby all the proportions are calculated, and every particular regulated both with respect to proportion, strength, and beauty.

The proportions will, of course, be regulated upon the principles established by experience. These teach that a ship should not be too long with respect to breadth, nor too short with respect to depth. Length, although highly desirable to a certain degree, if carried to excess, will, as we have shewn, be prejudicial; and, when ships are extremely long, they must have an extraordinary allowance of timber and planking to make them equal in strength to those which are shorter.

The LENGTH BETWEEN THE PERPENDICULARS, in most ships of war, is the length on the gun or lower deck, taken from the aftside of the rabbet of the stem to the foreside of the rabbet of the stern-post at the height of the lower deck: and, in merchant-ships, from the aftside of the stern-post, at the height of the wing transom, to the foreside of the stem at the same height (See Table of Dimensions and Scantlings, folio I.)

In ships of war the length is regulated by the number of ports intended to be made on the Gun-deck; and the disposition of the timbers by the situation of the ports. The latter should be so disposed as to weaken the ship as little as possible, and so as to avoid cutting off any of the principal timbers, &c. and, in placing them, we must consult the situation of the frames, which is every other bend throughout the ship, and of which the joints are represented by perpendicular lines in the square body, and by ticked lines in the cant bodies, agreeably to their thwartship appearance. (See Disposition of the Frame, Plate 2.)

The foremost and aftermost ports being determined upon, the intermediate ports will be at equal distances asunder, according to the room and space; and double the room and space must be always sufficient to allow for the width of the port, the siding of the frame timbers, and openings between the frame timbers, if any.

The foremost port should be as far forward as circumstances will admit, leaving room for the manger, for the purpose of firing the foremost gun, fore and aft, as a bow chaser. In the eighty-gun ship the most convenient place will therefore be to place it between the frames U and X, and equally distant from each; it will then be placed in the most superior point of strength, having a long top-timber on the foreside and a long fourth futtock on the aftside of it. The other ports may be placed in like manner, with respect to strength, taking care to have two frames between every two ports, all fore and aft, and they will all be equally spaced; taking care, at the same time, that there shall remain sufficient room for the quarter galleries, clear of the after port.

The foregoing are the first considerations which must take place in the formation of a draught for a ship of war with regard to length. In merchant ships, as having no ports, the disposition of the timbers may, of course, be regulated more simply.

Having fixed the length, the BREADTH is the next object to be considered, and this will be regulated by that proportion which is deemed most advantageous for the intended services of the ship; or, by that which has been established by the best practice. The latter may be readily seen by a reference to folio I, of the Table of Dimensions and Scantlings hereafter: or to the draughts which illustrate the present work. By the Table it will be seen, that ships of war, in general, have their moulded breadths about three-elevenths of their length, and merchant ships about three-twelfths, excepting Cutters and some other smaller vessels.

DEPTH IN HOLD is the next dimension to be considered in the construction of the draught. This dimension depends upon the placing of the lower deck, as it is generally taken from the upper side of the lower deck beam, in the midships, to the upper side of the strake next the limbers.

The depth in hold in ships of war depends upon the heights of the ports above the water, which should be as high as possible, consistently with the stability of the ship. This is, as we have already shewn, a prime consideration. In line of battle ships the depth in hold is, generally, about seven-sixteenths of the moulded breadth; and, in frigates, seven-twentieths. In merchant ships it is regulated by the trade they are designed for. Ships, built for the East India trade, in general, have their depth in hold, fourteen feet nine inches; which will admit seven heights of tea, or nine of china.

West India ships have, generally, a depth in hold, of about twelve feet, which enables them, with the deck above, to stow five heights of sugar.

And thus the depth in hold of every merchant-ship should be regulated according to the trade she is designed to follow. Her species of merchandize being known, the lower deck should be so placed as to obviate any loss in stowage.

The length, breadth, and depth in hold being settled, the upper part of the ship is next to be considered. The upper works should be kept as low and as snug as possible, particularly abaft, in order to have a handsome stern. The length of the round house deck must determine the height of the sheer abaft; and the round house should be no longer than is just sufficient for necessary accommodations; for, the shorter the round house the lower will be the works abaft; and a low snug stern is always considered as the handsomest.

The proportioning of the heights afore and abaft is of consequence, inasmuch as it has been universally found that, if a ship be constructed nearly straight, without a proper regard to her sheer, her strength would be proportionably less, and the weight of the extremes would soon cause an alteration in the sheer, by which she might be strained until it would be entirely broken. The quicker the sheer is, the more it contributes to the strength of the ship, and the more room it makes for accommodations with regard to the heights afore and abaft. This property is, however, most suitable to large ships, which carry many officers and require the most accommodations. In small ships, that are built principally for expedition, without a round house, and having few officers, the sheer is, of course, more straight, and kept as snug as possible, or so far as strength will permit.

Of the several heights now to be considered, the first is, the proportional height of the top-breadth, or top-timber line, at the lowest place or midships. This may be, for ships of war of three decks, seven-thirtieths of the length ; of two decks and under, about one-fifth of the length; and, for merchant ships, five twenty-thirds of the length. The latter, however, being reduced to no fixed rule, will be found to fluctuate accordingly, as may be seen by a reference to the general dimensions.

The HEIGHT of the LOAD-WATER LINE now demands our attention. This may be placed, in three deckers, at twelve twenty-thirds, or little more than one-half of the height of the top-timber line; in two-decked ships, at three-fifths of the top-timber line ; and, in other ships, in general, at about five-eighths of the height of the top-timber line, at the lowest place : remembering to set up the height of the load water line from the underside of the keel.

The height of the lower edge of the wale, and lower height of breadth, in midships, is generally placed nearly at the same height as the load-water line; but we would recommend it to be placed a few inches higher. The lower height of breadth being lifted afore and abaft about the height of the hawse holes forward, and a little above the wing transom abaft, or as the shape of the body may require.

The foregoing are, therefore, the principal points to be attended to in the proportioning of a ship. Other particulars may be varied according to the service for which she is designed. If the depth in hold required be greater than the proportions herein mentioned, it must be gained from the heights between the decks, as it is of the utmost importance to keep the ship, proportionably, as low above water as circumstances will permit.

The WALES are a principal part, and come next under consideration. The Main Wales should be placed on the greatest breadth, that being the part which bears the greatest strain, and so as to be bolted through with the main deck knees, in order to bind and strengthen the deck. Upon the Wales the strength of the ship very much depends; they must, consequently, be so placed, as to be cut or wounded as little as possible by the formation of the ports. The height or sheer of the Wales forward and aft, must be parallel, or nearly so, with the top-timber line.

The CHANNEL WALES are principally intended for the strength of the topside, and must be placed between the lower deck ports and the ports next above. The lower edge of them, in midships, should be placed low as possible, in order to prevent their being cut by the ports afore and abaft, by which we shall find them clear of the ports, excepting, perhaps, two or three of the after ports, which will be of little consequence, as the clamps of the deck next above, on the inside, will make good the deficiency of the wales in that place ; and the deck bolts will come in the wales every where else fore and aft.

The same may be said of the Sheer Wales in three decked ships, which come between the middle and upper deck ports.

The Channels are generally so placed that their upper edges may range with the upper edge of the sheer-rail; or so that all the preventer plates shall be placed on the Channel Wales; letting the plates be of such a length that the chain bolt and preventer bolt may come near each edge of the Wale. It must also be observed, that the chains be kept clear of the ports; and, that each of the chains and preventer plates has its proper rake, so as to lie in the true direction of the shrouds.

It now becomes requisite to take some notice of the height of the rising line, or centres of the floor sweeps *; the heights of which, and narrowing or half-breadth of the same, determines the form of the lower part of the body of ships in general, although some constructors form this part of the body without it.

Previous to the determination of the heights of the rising line, we must, of course, determine on the dead-rising, or its height at the midship timber. This will limit its height at that place; and, although, in *Whole Moulding* †, the rising line, all fore and aft, is parallel to the lower height of breadth line, yet, upon better principles, the curve of the rising varies according to the ideas or judgment of the artist, so as to give the lower part of the body of the ship such a figure as theory and experience dictates for the best.

It may here be observed, that the rising line cannot, from its nature, be found by a regular proportional method, from which there can be no variation without impropriety: nor can it be constructed to any fixed proportion unless ships of different classes were built exactly similar to each other; because, the rising line, in ships of war and those which are calculated for velocity, though suitable to the construction of the lower part of each ship, and likely to answer the purpose for which they are designed, cannot be equally proper for ships of the same length and breadth, if required chiefly for burden; as, in the last case, not only the form of the midship bend, but every other part of the bottom, must be on a different plan.

For the Height and Moulded-breadth of the ship at the Wing Transom, we refer the reader to the principal dimensions given in the tables hereafter; being those of ships selected as the best vessels of their respective classes.

We shall now speak of the ornamental parts of construction, &c. and, first, of the head.

The Head of every ship is intended both for ornament and convenience. In the first instance, as an ornament to the structure, the beauty of this part is more admired, and the deformities sooner discovered, than in any other part; for the head is, universally, the object most noticed by the generality of spectators, and many competent judges of naval architecture will assert that the symmetry of the whole depends much on the proportion or disproportion that it bears towards the head. For the appearance of a head, having all its parts well and neatly formed, with a due proportion and harmony between them, strikes the eye of the beholder with admiration; and the head may always be fashioned so as to make it beautiful.

* See the article Frames, in the "Explanation of Terms," &c. Ch. I. B. I.

† See the article Whole Moulded, in the "Explanation of Terms," &c.

The conveniences of the head are, to tack the weather clue of the foresail forward, to gammon the bowsprit, to water the provisions, and for seats of ease. With regard to tacking of the foresail forward, the head is of principal use, as also to trim the sail to the wind, so that the lee-leech may not bag, and oppose the motion of the ship; it may therefore be inferred, that short heads are not proper, because they require the boomkins at their outer ends to be in distance from the foremast, so as to plumb with the fore yard arm, when braced sharp, for the tacking of the sail forward.

The heads of all ships should be, as much as each class will admit, proportionably light and airy. In ships having three decks, the form of the head and rails will be most disproportionable. But, in order to help the same as much as possible, the length of the head must be so much longer than has been usual, which will take something off from the great depth. But, as heads in general, particularly long heads, are a great overweight to the ship, we would recommend the figure, or carved work, to be as light as possible; and, the means whereby we may take off more will be, to let the distance between the cheeks be more than has been general. Therefore, let the distance from the lower edge of the lower cheek, at the stem, to the lower edge of the cheek on the stem, be three-fourths of the distance from the lower edge of the lower cheek to the lower edge of the main rail at the stem. The lower cheek must be kept well, or nearly so, on the upper strake of the main wales, in consequence of the hawse holes coming between the cheeks, which are on the lower deck. The main rail, also, keeping it as low and level as is possible in the bag or curvature, for the convenience of the gratings, cannot be any lower than the surface of the upper deck. The intermediate rails between the upper cheek, and main rail may be equally spaced at every head timber, observing to let one of the middle rails form a curve with the supporter of the cat head, which may best clear the bow-port.

The timbers of the head, which support the rails, and keep them together, are always three and sometimes four afore the stem, and one abaft it (in large ships). The foremost head timber should be placed so as to range with the heel of the figure; one should be placed, its siding before the stem (termed the stem-timber) the other timbers exactly in the middle between; and, that abaft the stem, may be at the same distance from the stem timber as those afore it. Eighty and seventy-four gun ships, having only two decks, and, in consequence thereof having a snug topside, it is so much the easier to form, for these ships, a handsome and proportional head. Therefore, the situation of the hawse-holes may here determine the position of the upper edge of the lower cheek.

The main rail in the bag, and in wake of the stem, should be on a level with the upper part of the beakhead; and, if convenient, the upper cheek at the stem may be exactly in the middle between the main rail and lower cheek. The remaining parts may be formed according to fancy, only observing always to keep the fore part of the rails and head well up, so as to form an agreeable flight to the sheer of the ship, and, as the spacing of the rails, the number of them, and likewise the stem-timbers, are just the same as before described, it will be unnecessary to give any farther detail of them here.

Sixty-four and fifty gun ships. This class has not so snug a topside as the last, for the number of guns being considerably less, the length of the ship is consequently less, in proportion. But the guns, by being carried upon two decks, make these ships require a topside almost as high as the former class, by which they are much higher in proportion to the length than the ships above-mentioned; however, in order to make the head appear as handsome as possible, keep the cheeks as high as circumstances will admit. Therefore, let the upper edge of the lower cheek be kept up so as to have bolsters of a substance of only five inches under the hawse-holes. The main rail in the bag, and in wake of the stem, should be on a level with the upperside of the beak-head, which should never be higher than to range with the upper-side of the lower sills of the upper deck ports above the deck. The upper cheek at the stem is to be placed in the middle between the lower cheek and main rail.

Forty gun frigates and vessels carrying their guns upon one deck, afford the fairest opportunity of forming a handsome head and set of rails, by reason of a snug and shallow topside; in consequence of which, we must keep the rails and cheeks pretty close; and, by throwing the fore-part of the rails and figure well up we shall have a light airy head, which will always appear well out of water.

Let the upper edge of the upper cheek, at the stem, be just sufficient to have about four inches whole wood of bolster under the hawse-holes, on the foreside, to keep the rub of the cables from the cheeks; for, in this class of ships the hawse-holes are above the upper cheek, and the cheeks may be kept about one foot ten inches asunder. In lesser ships at the stem, one foot four inches.

Let the distance from the upper edge of the upper-cheek to the upper edge of the main rail at the stem, be the same as the distance from the upper edge of the lower cheek to the upper edge of the upper cheek. There is only one rail between the upper cheek and main rail, equally spaced between, the after end of it breaking in with a fair curve to the supporter of the cathead. The timbers, &c. similar to the foregoing.

The heads of merchant ships, in general, may be considered under this class; and what has been just directed will be the most applicable thereto.

The knightheads, or bollard timbers, must run sufficiently high, above the bowsprit, to admit of a chock coming between them for the better security of the bowsprit. The timber heads, along the forecastle, should always be so conveniently placed that the timbers of the frame may correspond, which will be those timbers that come over the upper deck ports; so that they may be allowed long enough to form handsome heads. This must be particularly attended to in those ships which have had, according to recent practice, timbers to run up high enough to take a rough tree rail round the bow. There should be one timber head placed close afore the cat-head for the cat-block to bolt to, and the after part of the main rail of the head, is to bolt to that timber likewise. There should also be two or three ports, on each side of the forecastle, formed by the timber heads; placing the ports where they may be most convenient to be clear of the shrouds.

Lastly, the fore part of the knee of the head may be formed by a handsome serpentine line, observing, in forming of it downwards, not to let it be too full; as, in that case, it will not only look clumsy, but will always be liable to rub the cable very much. It should, therefore, have no more substance under the lower cheek at the heel of the figure, than is just sufficient to admit of the bobstay holes. As a further prevention, let the foreside be well rounded.

The Sterns of all ships should be kept as low and as snug as possible, consistently with the size and force of the ship, the stern, being terminated above by the taffarel, and below by the counters, and being limited on the sides by the quarter-pieces, comprehends in the intermediate space, in large ships, the ward-room lights and galleries; and, in small ships, the great cabin windows only.

What has been said, with regard to the beauty and usefulness of the head, may, in some measure, be applied to the stern; the beauty of the stern being the grand ornament to the after part of the ship. In order to produce one that shall be handsome, the counter-rails must have a handsome round-up and round-aft, which will produce a light and airy appearance. Each rail continuing to have more round-up in proceeding upwards.

The sterns of large ships in the Royal Navy have lately had no open balcony; but, like those of some East India ships, have been wholly inclosed, which makes them very snug, and adds considerably to the strength of the stern. The timbers running all the way up give, at the same time, a better opportunity for forming the ports more advantageously to fight the guns right-aft.

If a stern be unavoidably deep, the lower and second counters must be made deep in proportion. The lights less in number and deep also; and some light carved work or device should be formed between the head of the lights and taffarel, because the latter would otherwise appear too deep, as a single stern will always appear on a near view much better than an artificial double one.

The knuckles of the counters must be so disposed that the lower and second counter shall be in proportion to the whole of the stern.

The heights of the decks must be next considered; for sometimes, in order to give depth for the lights, the decks are necessarily sprung abaft, and their round-up must be made conformably thereto.

The Quarter-Galleries. The heights of the Quarter-Galleries depend upon the stern; but, to make them handsome, the lower-rim should be as long as possible, and may spread within a few inches, if necessary, of the main-breadth amidships; for, as the whole quarter must be regulated by the lower-rim, if that is short or stunted the whole quarter-gallery will appear crampt.

Every thing relative to the head and stern being now sufficiently described, we may proceed to the rudder, which must be particularly considered, as many of the qualities required in a ship depend in a great measure upon the rudder; therefore, we must first determine on the breadth of it at the heel, or lower end, with the back included, which may be one-eighth of the moulded breadth, for ships in the navy in general. But, for merchant ships, or those constructed chiefly for burden, it may be one-seventh. The breadth at the heel being determined, the height of the lower hance may be fixed at about one-foot above the load-water line, and its breadth there should be three-fourths of the breadth at the heel, for ships in the navy, and two-thirds only for merchant ships in general. There may also be another hance at about the height of the lower deck. The use of the breaks or hances is, merely to reduce the breadth as it rises towards the head, the greatest breadth being only required below the water, where it feels the motion of the ship.

The rudder being more impelled by the water at the height of the floating-line than at the keel, since the fluid exactly follows the outlines of the bottom, some constructors, particularly the French, have been induced to make the rudder broader towards the load-water line and narrower towards the keel. For the usual proportions of the rudder, according to the usual practice, see the Table of Dimensions and Scantlings hereafter.

The most advantageous angle that the rudder can be placed in, when it be required to turn the ship, is allowed to be at forty-five degrees with the line of the keel prolonged; but the general practice is, to beard its foreside to two-fifths of its thickness each way from the middle line.

It has been customary to beard the rudder to a sharp edge at the middle line, by which the main-piece is reduced more than necessary, as is readily perceived in large ships; for we may observe, that when the rudder is put hard over, the bearding will not touch the stern-post by nearly an inch; to obviate which, the rudder should be bearded from the side of the pintles, and the foreside made to the form of the pintles. Again, as the upper pintle has always wounded the main-piece of the rudder so much with this mode of bearding it, let the aftside of the stern-post be bearded or tapered about one-fourth of its thickness, athwartships, and then the rudder will be bearded so much the less. This, also, will greatly assist the conversion of the stern-post.

It is proper here to notice an improvement in the rudder, which has taken place within these few years, and has been adopted in many ships, particularly in most of those in the service of the East India Company. It will, however, be requisite previously to describe the usual form of the rudder, in order to shew the advantages of the new method.

In the Sheer Draught of the eighty gun ship, (Plate 1.) the rudder is represented according to the common method of construction; in which the centre of the pintles that are parallel to the aftside of the stern-post is the axis of rotation. It is hence evident, that a space considerably greater than the transverse section of the rudder at the counter, must be left in the counter for the rudder to revolve in. The figure abaft the wing transom, in the sheer plan, which is a section of the rudder at the counter, shews that there must be a space in the counter similar to that round the rudder in the section, in order that the rudder may be moveable as required.

Hence, to prevent the water from washing up the helm port, or rudder hole, a rudder coat, that is, a piece of tarred canvas, is nailed in such a manner, to the rudder and counter, as to cover the intermediate space: but the canvas being continually washed by the sea, soon becomes brittle, and unable to yield to the various turns of the rudder without breaking; in which case the ship is, of course, left pervious to the waves, even of three or four feet high; in fact, there are few men bred to the sea who have not been witnesses to the bad effects of such a space being left so ill guarded against the stroke of the waves; and many ships have been supposed to founder at sea from the quantity of water shipped between the rudder and the counter.

It was to remedy this defect, that the alteration above alluded to took place; which consists in making the upper part of the rudder cylindrical, and giving that part at the same time a cast forward, as may be clearly seen in the Sheer Plan of the East Indiaman in Plate 20; so that the axis of rotation may thus be represented by the ticked line, passing, as usual, through the centres of the pintles which attach the rudder to the stern-post, and thence to the head, through the axis of that cylindrical part; in order that the transverse section of the rudder at the counter may be a circle revolving upon its centre. In this case, the space between the rudder and the counter need be no more than just sufficient to hang it; and, consequently, the necessity of a rudder coat is done away. But, as it was foreseen, that, if the rudder by any accident was unshipped, this alteration might endanger the tearing away of the counter, the hole is made somewhat larger than the transverse section of the cylindric part of the rudder, and the space between covered over with a rim of wood fitted to the counter, so as to be capable of withstanding the shock of the sea, but to be easily carried away with the rudder, leaving the counter, under such circumstances, in as safe a state as it would be in according to the present mode of making rudders in the navy. Again, the rudder, being cylindrical in that part, the wooden rim is fitted nearly close; but, to prevent the least water from entering the ship, a leathern hose is fitted as closely as possible.

The Centres or Places of the Masts, upon the gun or lower deck, may be determined upon thus: the foremast may be about one-ninth of the length between the perpendiculars abaft the foremost perpendicular, for ships in the navy, and two-thirteenths in merchant ships. The centre of the main-mast to be five-ninths of the length abaft the foremost perpendicular for all ships in general, and the mizen-mast in large ships four twenty-fifths of the length afore the after perpendicular; and, in smaller ships, as frigates, &c. four-twenty-sixths.

For Brigs, or vessels with two masts, the foremast to be one-eighth of the said length abaft the foremost perpendicular; that is to say in sharp vessels; but, in full vessels, as the Colliers, &c. it is to be about one-seventh. The main-mast to be three-fifths of the length abaft the foremost perpendicular.

But Cutters, and one masted vessels in general, have the centre of the mast about one-third of the length from forward.

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§ 2. OF THE CONSTRUCTION OF THE SHEER DRAUGHT OF THE EIGHTY GUN SHIP, FROM THE GIVEN DIMENSIONS.

*** *In the directions for the Construction of the Sheer Draught, as well as for those of the other plans, the references are, throughout, to the draughts of the Eighty gun ship, Plates I. to VI. upon which the name of every essential particular may be found.*

The first thing to be determined upon is the length on the gundeck, or distance between the fore and after perpendiculars, which is, as given in the table of dimensions, 182 feet. Draw, therefore, a straight line on the paper, representing the upper edge of the rabbet of the keel, taking care to let it be at a sufficient distance from the lower edge of the paper to admit of the scale and the half breadth plan beneath. Erect the perpendicular, named the foremost perpendicular, on that end to the right, (allowing sufficient space on the paper for the projection of the head and rails); thence set off 182 feet, the length of the gundeck, and there erect the after perpendicular. Then draw the scale of feet and inches, numbering it as marked on the Sheer Draught.

The stem now may be formed; in order to which, the centre for sweeping the stem, taken from folio II. of the dimensions, must be set off thus: fix one leg of the compasses in that centre, and the other in the line for the upper edge of the rabbet of the keel; thence describe a segment of a circle upwards towards the foremost perpendicular, and then, from the same centre, describe another circle beyond the former, as much as the stem is moulded. Another circle must now be drawn, from the same centre, before the inside of the stem to, and parallel with, the thickness of the bottom plank. Then set up the height of the head of the stem from the dimensions, and its distance before the foremost perpendicular; make a spot, and abaft that set off the moulding of the stem, and there make another spot; from the last mentioned spot let a curve line pass downwards, breaking fair into the sweep of the stem by which the aftside of the stem is drawn; then, by letting another curve line pass from the foremost spot at the head of the stem downwards, parallel to the aftside, breaking in fair with the outer circle, the whole stem will be formed, excepting the after or lower end, which cannot be determined upon till hereafter.

The stern-post may next be drawn, thus; set up from the dimensions, above the upper edge of the rabbet of the keel, the height of the wing transom at the after perpendicular; there draw a horizontal line, and then draw another line parallel with and below it, to the margin or lower side of the tuck rail, upon which set off a spot for the aft part of the rabbet of the post, taken from the dimensions, and thence another spot may be taken. Set off upon the upper edge of the keel, a line drawn to intersect those spots; which will represent the aftside of the rabbet, then, a parallel line drawn before that, to the thickness of the bottom plank, will intersect the after perpendicular at the height of the lower deck; and, where this foreside of the rabbet intersects the horizontal line is the aftside of the wing transom. From the aftside of the rabbet, on the horizontal line, set aft the distance of the aftside of the stern-post, and likewise set aft the distance of the aftside of the stern-post from the rabbet on the upper edge of the keel, both taken from the dimensions; then, a straight line drawn to intersect those spots will shew the aftside of the stern post. Thus will the stern post be described for the present, as the head will not be determined till hereafter.

Next proceed to set aft the distance of dead-flat from the foremost perpendicular; and, at that place, erect a third perpendicular, which is distinguished by the character ⊕; the broadest and fullest part of the ship, and termed the midship bend. From dead-flat the stations of all the timbers must be set off; but it will be only necessary to erect a perpendicular at every frame timber, (omitting the fillings,) which are in the fore body called dead-flat, B,D,F, &c. and in the after body (3), (5), 2, 4, &c. and the distance between the frame perpendiculars will thus be double the room and space given in the dimensions.

Then proceed to set up the heights; all of which must be done from the line representing the upper edge of the rabbet of the keel. First set up the heights of the lower deck at the three perpendiculars, afore, in midships, (or at dead-flat,) and abaft; then, by moulds which are portions of circles, (termed sweeps,) or a bow, draw a curve line through these three heights, and the upperside of the gun-deck will be formed. Now, setting off the thickness of the gun-deck plank below the curve last drawn, let another line be drawn parallel thereto, and the gun-deck will be described as at the middle line in the sheer-plan.

Next proceed to draw the upper deck in; set up three heights between the gun and upper deck, (afore, amidships, and abaft,) taken from the dimensions, through which heights draw a curve; then set up the thickness of the deck, and draw another curve, parallel to the former; the upper deck will then be represented at the middle line of the sheer-plan.

The stern-timbers should next be drawn. Set up the height of the lower counter at the middle line, from the upper edge of the rabbet of the keel, and draw an horizontal line in pencil; on this horizontal line set aft the distance which the knuckle of the lower counter is abaft the after perpendicular, taken from the dimensions; then make a spot, from which spot, to where the fore-part of the rabbet of the stern-post intersects the line drawn for the upperside of the wing-transom, draw a curve to the hollow of the lower counter; which curve will represent the lower counter at the middle line.

Then set up the height of the upper counter, at the middle line, from the upper edge of the rabbet of the keel, and draw an horizontal line as before; thereon set aft the distance which the knuckle of the upper counter is abaft the after perpendicular; then, drawing a curve thence to the knuckle of the lower counter, the upper counter will likewise be described at the middle line.

Having the upper and lower counters drawn at the middle line, the upper part of the stern-timber above the counters must be drawn as follows:

Set up, above the upper edge of the rabbet of the keel, the height of the upper part of the taffarel, from the dimensions; there draw an horizontal line; and set aft thereon the distance of the stern-timber from the after perpendicular; make a spot, and then, drawing a straight line from the knuckle of the upper counter, to pass through the said spot, the upper part of the stern-timber will be drawn, by which the rake of the stern will be described.

As the stern rounds two ways, both up and aft, (or forward from the timber already drawn,) the stern-timber at the side will consequently alter from that at the middle line, and therefore remains to be represented. Take, from the dimensions, how much the upper counter rounds up, and set it below its respective knuckle at the middle, drawing a horizontal line in pencil; then take how much it rounds aft, and set it forward from the knuckle on the horizontal line first drawn; square it down to the line last drawn, in pencil, and where it intersects make a spot, which will be the knuckle of the upper counter at the side. Then proceeding, in like manner, with the lower counter, the knuckle for the lower counter at the side will be produced; and, by drawing a curve from the knuckles at the side, (similar to the curve or hollow at the middle line,) the upper counter at the side will be also formed.

To draw the lower counter at the side.—Take the round-up of the wing-transom, from the dimensions, and set it off below the horizontal line before drawn for the height of the wing-transom; and there draw another horizontal line in pencil. Now, take the round-aft of the wing-transom; set it forward, on the upper line, from the aftside of the wing-transom; then squaring it down to the lower line, the intersection will be the touch of the wing-transom at the side. Again, by drawing a curve, (similar to the curve or hollow at the middle line,) from the knuckle of the lower counter at the side to the touch of the wing-transom, the form of the lower counter at the side will be formed.

The upper part of the side stern-timber only now remains to be drawn to complete it. But, as a straight line, which must be drawn for the upper part of the side-timber, should not be parallel to that at the middle line, the following method will determine the exact rake thereof. Draw a straight line, at pleasure, on which set off the breadth of the stern at the upper counter; then, at the middle of that breadth set off the round-aft of the upper counter; draw a curve or portion of a circle that shall intersect the spot set off at the middle and the spots at the breadth, and the round-aft of the stern will be described at any part of its breadth above the upper counter: thus, take the breadth of the stern at the top-timber line, from the dimensions, and set it off equally on each side the middle to where it shall intersect the round-aft; thence draw a line, parallel to that first drawn, and the distance between the line last drawn to the curve at the middle, is the distance that the side-timber will be from the middle-timber, on a horizontal line, at the height of the top-timber line*.

The rake of the stern-timbers being determined, proceed to finish the decks, by drawing in the quarter-deck and forecastle; which may be done by taking their respective heights and lengths from the dimensions, and drawing their curves. In the same manner may the round-house deck be drawn.

All the decks having been drawn in, representing their heights at the middle, we must now proceed to draw their heights at the side. To do which correctly, take the round-up of the beam of its respective deck from the table of dimensions, and set it up in the middle of a line drawn at pleasure: then, on each side of the middle of this line, set off the half-breadth at dead-flat, or the broadest place, taken at the height of the deck. Then raise an arc †, that shall intersect the round-up set off at the middle, with the spots at the breadth, and the round-up of the deck will be described at any part of its breadth. Thus, take the half-breadth at the height of the deck at any timber, in the body plan, and set it off equally from the middle of the round-up till it intersects the curve; whence draw a line parallel to that first drawn, and the distance between the line last drawn to the round-up curve in the middle, is what the beam rounds at that place. Thus may the round-up be taken at as many timbers as may be found necessary, and set below the underside of the deck at its respective timber in the sheer plan; then, a curve line passing through those spots will represent the deck at the side: but observe, that the decks are to have a sufficient round abaft, to correspond with the round-up of the stern above the lights.

The sheer or top-timber line may now be drawn; which is done, by taking its heights from the table of the dimensions of bodies, and setting them up in the sheer plan at its respective timbers: then, by drawing a curve through those spots, the sheer of the ship or top-timber line will be represented.

* This may be seen most clearly represented on Plate 38.

† See the manner of constructing an arc, under the article Arch, in the explanation of terms, Chapter I. Book I.

The ports may next be drawn, thus: draw two curves, in pencil, fore and aft, for the lower and upper parts of the lower-deck ports, by taking from the table of dimensions their depths and heights from the deck; drawing the two curves parallel to the deck at the side, and observing to add the thickness of the deck; as the line for the deck at the side represents the underside of the deck, or upperside of the beam.

The fore sides and aft sides of the ports may next be squared up between the two lines last drawn; placing the foremost port and after port agreeably to the distance given in the dimensions, as also the intermediate ones.

In the same manner may the upper-deck ports be drawn; observing to place them agreeably to the dimensions: those on the quarter-deck and forecastle must be placed where there is a vacancy between the dead-eyes to admit of them, observing to place them as nearly as possible at equal distances.

The round-house deck being drawn, let a line be drawn parallel to the top-timber line, that shall touch the round-house deck at the side, at the fore part, and continue thence quite aft: above which, set up the thickness of the planksheer, and draw another line parallel to the former; so will the extreme height of the topside be described abaft; which height continues to range fair along to the fore end of the round-house, where it finishes with an inverted scroll upon the planksheer, that completes the height of the side along the fore part of the quarter-deck, which is, in the eighty-gun ship, four feet four inches above the top-timber line and parallel thereto. The planksheer turns off with a round, abreast the main-mast, to unite with the planksheer at the main drift, which is three feet three inches above, and parallel to, the top-timber line, and turns off with an inverted scroll upon the drift-rail at the gangway.

The drift-rail may now be drawn, it being eleven inches below the underside of the planksheer at the main drift, and finishes with a scroll upon the sheer rail at the gangway; then rises with a scroll abreast the main-mast, where it is kept to the same distance below the planksheer, and thence continued parallel to the top-timber line quite aft. These lines being drawn, they represent the upper edges of the rails which are put on to embellish that part of the ship.

We may next proceed to the fore part of the ship, in order to delineate the height of the topside there. Let the break be at the after-end of the forecastle, and turned off with a scroll, as at the fore part of the quarter-deck, drawing the lines of the fore drift-rail and planksheer to the heights given above the top timber line in the dimensions, and parallel thereto.

The upper part of the ship being thus far complete, we have at one view the utmost extent of the sheer, as seen on a plane.

It now remains to represent the finishing parts, as the wales, stern, head, rails, &c.

Proceed to take the heights and breadth of the main-wale afore, amidships, and abaft, from the table of dimensions, and draw in their curves, by which the main-wale will be represented.

Next draw in the channel-wale, taking its heights and breadth from the table of dimensions; then draw curves through the spots as with the main-wale, and they will be represented.

The waist-rail may be next drawn. Its distance below the top-timber line may be taken from the table of dimensions, and kept parallel thereto, all fore and aft.

Now, from the Table of Bodies, set up the lower and upper heights of breadth, upon their corresponding timbers in the sheer plan, and draw curves through the spots so found, which will represent the lower and upper heights of breadth of the ship.

Then take the draught of water from the table of dimensions, and draw in the load-water line, which is always done in green ink: draw in, likewise, between that and the upper edge of the rabbet of the keel, four or more water lines, at equal distances between.

In the next place, the centres of the masts may be set off on the gun-deck, taken from the table of dimensions, and the rake of them likewise. The centre of the bowsprit and its stive may likewise be taken from the dimensions, set off, and the bowsprit drawn in.

The timber-heads may now be drawn in above the planksheer of the forecastle, and the starboard knight-head drawn in agreeably to its height, &c.

Now draw in the channels, taking their lengths and thicknesses from the dimensions, placing their upper edges, next the side, in a line with the upper edge of the sheer-rail. The dead-eyes may then be drawn, observing to place them in such a manner that the chains may not interfere with the ports. All the preventer plates must be placed on the channel-wales, and of such a length, that the chain and preventer bolt may come on each edge of the channel-wales. It must also be observed to give each of the chains and preventer plates a proper rake; that is, to let them lie in the direction of the shrouds; which may be done in the following manner: draw a line upwards for the centre of the mast, upon which set off the length to the lower part of its head; then, by drawing straight lines from that height, through the centre of each dead-eye, the direction of each chain will be obtained by the direction of its corresponding line.

In the next place, let us see that the fore channel is long enough to take the anchor-lining and bill-board for stowing the anchor, thus: get the length of the anchor to the bill, and allow for the cat-block; then sweep the distance so obtained from the cat-head aft, and the curve that the bill of the anchor is supposed to make will give the middle of the lining: the aftside from the channel may be perpendicular, and the fore-part follow the curve made by the anchor. The bill-board may then be carried upwards from the upperside of the channel to the top of the side. The anchor lining commences at the upperside of the bolster, which, in the eighty-gun ship, may be well with the upperside of the channel-wale, and long enough, at the fore-part, for a man to stand upon.

After finishing the dead-eyes and channels, the fenders may be drawn; observing to place them right abreast of the main hatchway, for the purpose of preventing the ship's side from being hurt by whatever may be hoisted on board. The distance between them may be governed by the distance between the ports, placing them asunder as the upper and lower deck ports afford an interval. The chestree must also be placed, for hauling home the main-tack, half the length of the main-yard before the centre of the main-mast, and drawn in from the top of the side down to the upper edge of the channel-wales. The fenders may reach from the top of the side down to the upper edge of the main-wales; and, as the fenders and chestree come on the outside of the planks, wales, &c. they must be so represented, by not letting the rails, wales, &c. run through them.

Proceed to draw in the steps on the side, which must be placed at the fore part of the main-drift, or gangway, about three feet in length, six inches asunder, and five inches deep, from the top of the side down to the load-water line.

Having formed the sheer-plan thus far, we may proceed to the finishing and ornamental parts, which are the Head and Stern. First draw in the Head, by first setting up the height of the beak-head, which should be of the same height as the upperside of the port sills, or lower sides of the ports above the deck; at which height draw an horizontal line; upon this line set aft the length of the beak-head abaft the fore part of the stem, as in the dimensions; thence square up a line to the forecastle, which line will represent the fore part of the beak-head, and will likewise determine the foremost end of the forecastle. The length of the head may now be set off from the fore part of the stem, as in the dimensions; and there erect a perpendicular, which will be the utmost limits of the figure forward; then, from the dimensions, take what the figure is fore and aft, and setting it off abaft the perpendicular last mentioned, another perpendicular may be erected, which will shew the utmost extent of the hair-bracket forward, or the aft part of the figure.

In the next place, draw in the cheeks, taking their heights and sidings from the dimensions; then draw curves to rise fair with the sheer of the wale, lifting gracefully forward. The lower side of the lower cheek breaks in fair with the foremost perpendicular of the figure, and the lower side of the upper cheek breaks in fair with the perpendicular at the back of the figure, and forms the fore-side of the hair-bracket*. The upper sides of the cheeks may now be drawn in; and, as they taper all their length, may be regularly diminished. Set off from their after ends (which are squared up from the main half-breadth line) a number of equal divisions, suppose each to be two feet, quite forward to the foremost end, and each division regularly numbered; then draw a straight line, at pleasure, upon which set off the same number of equal divisions. Having done this, set off, at the after end and foremost end, the siding or depth of the cheek; through the spots which distinguish this draw another straight line; then, at each division, take its tapering, and set it off at its respective division above the line already drawn on the sheer-plan. A curve drawn through the last-mentioned spots will represent the uppersides of the cheeks; observing, that the upperside of the lower cheek stops at a perpendicular line let fall from the heel of the foremost head-timber. The upperside of the upper cheek runs in a handsome serpentine line as high as where the shoulder of the figure is supposed to come; at which place it is turned off with a scroll. *See Plan of the Head, Plate* 38.

The head of the figure, or block, may be formed, by continuing the line from the breast of the figure to the top of the hair-bracket, observing to keep the top of it from four to six inches clear of the underside of the bowsprit.

Now take the height of the upper side of the main-rail from the dimensions, and proceed to draw it in; keeping the bag of it as level as possible, for the convenience of the gratings, and letting the foremost end rise gradually, accordingly to the rise of the upper cheek and hair-

* The Hair-Bracket extends from the scroll down to the heel of the foremost head-timber.

bracket. Then, to form the after end, set off the moulding of the head of the rail abaft the beak-head line, and erect a perpendicular; then draw in a curve from that perpendicular, to break in fair with the lowerside of the main-rail in the middle, and likewise another from the beak-head perpendicular, to break in fair with the upperside of the rail at the middle. The main-rail may then be completely formed, observing the rule given for diminishing the cheeks, by which the rails and cheeks will appear with a regular taper. Observe to let the head of the main-rail run up sufficiently high to range with the timber-heads above the forecastle, or higher, that many turns may be taken by the anchor-stopper.

The head-timbers must next be drawn, placing the stem-timber perpendicularly its thickness from the stem, and the foreside of the foremost timber to stand perpendicularly over the heel of the block or figure; but, if it rakes forward at the upper part, it will produce lightness of appearance in the head. From the length of the figure, as taken from the dimensions, a perpendicular may be erected, from the lower part of the lower cheek to the lower part of the upper cheek; which perpendicular will terminate the foremost end of the lower cheek and lower end of the hair-bracket, as before observed. The thickness of the stem-timber, and also the foremost one, may be then drawn in, and the head-timbers between them equally spaced. Then another timber may be placed abaft the stem, at the same distance abaft the stem-timber as that between the others, and the lower end of it may step on the upper edge of the lower rail.

The head-timbers being drawn, proceed to draw in the middle and lower rail; which may be done by dividing the space between the lower part of the main-rail and the upper part of the upper cheek, equally at every head-timber; and drawing curves to pass through those spots, the middle and lower rail may be formed, letting the after end of the lower rail terminate where it touches the side.

The cat-head may next be drawn, letting it project from the aftside of the head of the main-rail, to rake forward about four inches in every foot without board, or stand square with the bow, and to stive upwards about five inches and a half in a foot; observing that the lower part comes on the plank of the deck at the side; and the supporter under it must form a fair curve, to break in with the after end of the middle-rail.

The hawse-holes in ships of this class come between the cheeks, but their exact situation in the sheer-plan cannot be determined on, till we have them represented on the half-breadth plan, as shewn hereafter.

The knee of the head may now be drawn, letting it project from the breast of the figure about four inches; thence draw the fore-part of the knee, with an agreeable serpentine line, to its thickness from the stem about six feet below the load-water line; then, by continuing the same line downwards, and by drawing it more distant from the stem as it comes down, the gripe may be formed agreeably to the dimensions, letting the lower part break in fair with the under part of the false-keel. As the aft part of the gripe is terminated by the fore foot, or foremost end of the keel, it may now be drawn in likewise.

From the line representing the upper edge of the keel, set down the depth of the keel from the dimensions, and draw a line parallel to the former, all fore and aft; which will represent the lower part of the keel. Then, where the inner sweep of the stem rises above the line for the upper edge of the keel, as high as the keel is deep, erect a perpendicular from the lower part of the latter up to the fore-side of the stem, and thence let it be squared from the foreside to the aftside of the stem; by which the foremost end of the keel will be represented; and the boxing, or lower end of the stem, may be drawn, by setting aft the length of the scarph from the foremost end of the keel, and dropping a perpendicular there about half the depth of the keel. Continue thence forward a line parallel to the lower part of the keel for about one-third of the length of the scarph, where it will meet the foreside of the stem, and complete it.

Then set off below the line representing the lower edge of the keel, the thickness of the false keel; and, drawing a line fore and aft, parallel to the former, the false keel will be represented; the foremost end of which may be three inches afore the foremost end of the main-keel.

Having now explained every thing relative to the head, with respect to the sheer-draught, we shall proceed to the stern, and make a few observations, which will suffice for the present, as the stern will be more particularly and fully treated of hereafter in the laying it off in the mould-loft.

The side and middle timbers of the stern being already drawn, set off from the side stern-timber the length of the lower-gallery rim forward, and then draw a line, in pencil, parallel to the side counter-timber, from the knuckle of the second counter upwards, which gives the length of the lower gallery. Then, to represent the lower-gallery rim, upon the sheer-plan, the perpendicular plan of the stern must be designed, as explained hereafter, and exhibited in Plate 38.

In the manner above described may the lower counter-rail be formed, by setting off the distance between that and the lower-gallery rim, and there drawing in the rail which comes on the lower stool, keeping it parallel to the rim-rail. The lower finishing may then be formed beneath the lower stool-rail, with another stool, and a serpentine line as light and agreeable as possible.

In the next place, set aft, from the side timber, the projection of the balcony, (as given in the dimensions,) on the end of the quarter-deck, and draw a line, in pencil, parallel to the stern-timber; then the footspace rail of the balcony, as it appears in the sheer-plan, may be represented. *See Laying-off of the Stern hereafter, and Plate* 38.

Now draw a line, parallel to the rim-rail, in the sheer-plan, till it intersects the lower part of the footspace rail; and that line will represent the lower edge of the rail that comes on the middle stool and answers to the footspace rail; then, between this rail and the lower rim may be drawn in, three lights, or sashes, having a munion between each light, about twelve inches broad, (or, leaving that opening between each light or sash,) and thus we shall have the lower gallery finished.

Again, by setting up the depth of the footspace rail, as directed in *laying-off* the stern, its upper edge will likewise be represented; also the upper edge of the middle stool-rail, in the sheer-plan.

In the next place, proceed to draw in the quarter-piece; the heel of which must step on the after end of the middle stool: then set up the height of the upper part of the taffarel, from the dimensions, and there draw an horizontal line. The thwartship view of the taffarel and quarter-pieces may be represented in the sheer-plan, as described hereafter, and exhibited in Plate 38.

It is customary, instead of a fair curve for the upper part of the taffrail, to form it with one or two breaks, with their curves inverted; the student may therefore consult his own fancy in that respect.

Set upon the line drawn for the projection of the balcony, the height of the upper part of the balcony breast-rail, from the dimensions; and draw it in the sheer-plan as described in the laying-off of the stern hereafter, and Plate 38. The whole balcony will then be represented.

The upper gallery may now be represented by drawing the upper rim rail, parallel to the rail below, ranging it aft to the balcony breast-rail: then set off its length forward, from the dimensions, from the side counter-timber, drawing a line parallel thereto, which will represent the fore-part of the upper gallery.

The fore-side of the quarter-piece will represent the after-part of it. Now draw in the upper stool-rail, parallel to the upper rim-rail, at such a height as that the upper stool may not come below the cove of the quarter-piece. Then may three sashes be drawn in between those two rails as before, by which the upper gallery will be formed.

The upper finishing should next be drawn; determining on the length, which may be about eighteen inches shorter than the upper gallery; drawing a line parallel with the rake of the stern for the fore end of it. Then let the upper part of the topside be the upper part of the upper rail, set down below that about three inches for the thickness of the rail, and about nine inches below that; and, parallel to it, draw another rail, about three inches and a half thick; from the fore end of which draw a serpentine line down to the fore end of the upper stool-rail; then will the upper finishing be completed.

Every thing relative to the head and stern being now sufficiently described, we may proceed to the rudder. First, set off its breadth, at the lower part, or heel, from the aftside of the stern-post, which also represents the fore part of the rudder; then, set off the height of the lower hance and the breadth at that place, from the dimensions. Next draw a line thence to the breadth set off at the lower part, by which the aftside of the rudder will be described below the lower hance; then set up the height of the upper hance, and its breadth in the same manner, and draw it in, connecting it at the lower hance by a moulding. The back may be drawn, taking its thickness from the dimensions, and drawing in a line parallel to the aftside of the rudder, from the lower hance down to the lower end, to that thickness by which the back will be represented.

The head of the rudder is to run high enough to receive a tiller above the upper deck; therefore, set off the size of the head, fore and aft, above the upper deck, and draw a line thence down to the break at the upper hance, by which the aft part of the rudder will be represented all the way up. The bearding should be represented by drawing a line from the head of the stern-post down to the lower end of the rudder, at two-fifths of its thickness from the foreside. But observe that, although two-fifths of the thickness is found to beard the foreside of the rudder no more than is necessary, yet when it is wholly taken from the rudder the upper pintle wounds it very much; therefore, let the aftside of the stern-post partake of the bearding, and, by that means, the bearding on the rudder will be so much the less; and, consequently, much less wounded by letting on the upper pintle. In describing of the bearding on the rudder, in the sheer-plan, the most proper way will be to proceed as follows.

Draw a line at pleasure, (as at the upper side of the wing-transom in the sheer-plan,) from which set off half the size of the rudder at the wing-transom on each side of it, and draw lines parallel to the fore and aft dimension of the rudder; then square up a line at the foreside, and that will represent the aftside of the stern-post likewise: set off from the last line, or foreside of the rudder, two-fifths of the thickness, or what the rudder is athwartships, at that place on each side; and at the middle line, on the foreside, the size or diameter of the pintle; and thence draw a line, on each side, to the spots set off on the side, and you will have the shape of the bearding of the rudder at that place; then take how much the rudder is athwartships at the lower end; set it off equally from the middle line and parallel thereto, and we have the shape of the bearding at the lower end; then, the distance from the foreside of the rudder to where the bearding intersects the side must be taken at its respective places, and set off accordingly abaft the stern-post in the sheer-plan. A line being now drawn to those spots, the bearding will be represented exactly as it appears in the sheer-plan; that is, supposing the stern-post not bearded. It now remains only to say that, as much as the aftside of the post may be bearded, so much the less will be the bearding of the rudder from the two-fifths.

The pintles and braces may next be drawn; first determining on the upper one, which must be disposed of in such a manner, that the straps shall come round the head of the standard which fays against the helm-port transom on the gun-deck, and meet at the middle line, by which there is a double security both to the brace and to the standard. It must therefore be placed above the wing-transom to come in that situation. The second brace must be placed just below the gun-deck, so as to fasten in the middle of the deck transom, and the rest may be spaced equally between that and the lower one. The lower one may be placed about one foot above the upper edge of the keel. The number of braces in the table of dimensions for the eighty-gun ship will be found to be seven, but it may be regulated by the distance between the second and upper one, letting the distance between the rest be nearly the same.

The length of the braces will be found by setting off the length of the lower one, (which by the table is eight feet afore the back of the stern-post,) and likewise the length of the third, (which is four feet six inches afore the back of the stern-post); then, by drawing a line from one to the other, the lengths of the intermediate ones will be found, as they appear on the sheer-plan.

The length of all the straps of the pintles, which come upon the rudder, may be within four inches of the aftside of the rudder; and, the rudder being a flat surface, they will all appear of their true lengths.

The sheer-plan being thus far drawn, and every part thereof represented, as far as can be done without the assistance of the body-plan, we shall, in the next section, proceed to draw in the body and half-breadth plans; and, also, describe those parts of the sheer-plan which are not yet represented, on account of their connection with the body and half-breadth plans.

§ 3. OF CONSTRUCTING THE BODY AND HALF-BREADTH PLANS, WITH FURTHER OBSERVATIONS ON THE SHEER-DRAUGHT.

THE half-breadth plan must first be drawn; in order to which, draw a straight line below the sheer-plan, the whole length of the ship, and parallel to the upper edge of the rabbet of the keel, observing to keep it of a sufficient distance beneath the keel line, to admit of the main half-breadth line coming clear of the keel and scale; then, from the upper edge of the keel square down all the joints of the frames to the line just drawn, which line is the middle line in the half-breadth plan, and represents the middle line of the ship, passing fore and aft, or lengthwise. The foremost and after perpendiculars should also be squared down to the middle line in the half-breadth plan.

Now, where the height of breadth lines, in the sheer-plan, intersect the aft part of the rabbet of the stem, square it down to the middle line in the half-breadth plan; and, likewise, the fore part of the stem: then take, from the table of dimensions, what the stem is sided at that place, and set off half of it from the middle line in the half-breadth plan, on the lines so squared down; then, drawing a line to intersect the lines so squared, the half-breadth of the stem will be represented in the half-breadth plan: now, with compasses, take the thickness of the plank of the bottom, which is four inches, and describe the rabbet of the stem in the half-breadth plan.

In the next place, square down to the middle line in the half-breadth plan, where the height of breadth lines in the sheer-plan intersect the counter-timber at the side; also square down where they intersect the counter-timber at the middle line; then, when the main half-breadth line is run, the half-breadth of the counter will be given on the line first squared down. From the spot to where the line last squared down intersects the middle line, sweep a curve, the centre of which will be in the middle line, by which the half-breadth of the counter will be represented at the height of breadth, the broadest part of the stern.

Then take the main half-breadth of timber dead-flat from the table of dimensions, and set it off from the middle line on dead-flat in the half-breadth plan; take also from the dimensions of bodies the main half-breadth of every timber there expressed, setting them off respectively from the middle line on their corresponding timbers in the half-breadth plan; then, by letting a curve line pass from the end of the line representing the half-breadth of the counter, through all the spots set off on the timbers, to the aft part of the rabbet of the stem, the main half-breadth line will be represented, by which is shewn a section of the ship lengthwise at the broadest place, supposed to be at the height, and in the direction, of the height of breadth lines in the sheer-plan.

Now take, from the dimensions of bodies, the top-timber half-breadth, by which the top-timber half-breadth line may be described, proceeding in the manner above described for the main half-breadth line.

Take also from the dimensions of bodies the half-breadth of the rising, and set it off from the middle line on the corresponding timbers in the half-breadth plan, observing where the word *outside* is expressed in the tables, the half-breadth for that timber must be set off below (or outside) the middle line; then, by drawing a curve to intersect all the spots set off, the half-breadth of the rising will be represented in the half-breadth plan.

We may now quit the half-breadth plan for the present, and proceed to the body-plan. Draw a line at the after end of the sheer-plan, at the same height as the upper edge of the rabbet of the keel; then erect a perpendicular on that end nearest the sheer-plan, observing to keep it clear of the stern; from that line set off the main half-breadth of dead-flat, and erect another perpendicular; at the main half-breadth from that, erect a third perpendicular: the line first drawn is the base line, the first perpendicular is called the side line of the fore-body, the second perpendicular the middle line, and the third perpendicular the side line of the after-body; by which three lines, and the base line first drawn, we shall be able to construct the body-plan, as the heights and breadths must be all set off from those lines.

In the next place take, from the table of bodies, the heights of the diagonals up the middle line, and set them off from the base line up the middle line; take also, from the table, the distances of them from the middle line on the base line, and set them off; likewise their heights up the side line, and set them off also; then draw in the diagonal lines, from the spots set up the middle line to their corresponding spots on the base and side line.

The diagonals being drawn, we may next proceed to the height of breadth lines; therefore take, from the sheer-plan, the heights of the lower height of breadth line in the after-body, and set them off up the middle line in the body-plan, and likewise up the side line of the after-body; then, at every one of the heights set off, draw an horizontal line in pencil from the side to the middle line.

Now take off the upper height of breadth line, and proceed in the same manner as described for the lower height of breadth line.

The rising must next be set off on the body-plan; in order to which we must first describe it in the sheer-plan, by taking the heights from the table of bodies, and setting them off above the upper edge of the rabbet on their corresponding timbers in the sheer-plan; then, by drawing a curve to pass through the heights set off, the rising line will be described in the sheer-plan: next take, from the table, the rising height of dead-flat, and set it off in the body-plan, drawing an horizontal line; again, take all the rising heights from the sheer-plan; set them off in the body plan, above the line drawn for the rising height of dead-flat*, and draw horizontal lines at the said heights: take from the half-breadth plan the half-breadths of the rising, and set them off from the middle line in the body-plan, on their corresponding heights, which will give the centres of the floor sweeps for their corresponding timbers.

Now take, from the half-breadth plan, the main half-breadth line; and set it off from the middle line in the body-plan, on the corresponding lines already drawn for the lower height of breadth; then, from where they intersect the lines of their respective heights, set off the lengths of their respective lower-breadth sweeps.

* In the sheer-draught of the eighty-gun ship this height is represented by the upper edge of the rabbet of the keel, otherwise it would interfere with the upper works. In other ships, it may, of course, be varied according to the figure of the body.

Again take, from the table of bodies, the distance of each timber from the middle line on the diagonals, and set them off from the middle line on their respective diagonal lines, making spots at the different distances; then, having those spots set off, the lower-breadth sweeps described, and likewise the floor sweeps, the shape of the timbers below the breadth may now be described, as follows:

First, describe the midship-timber, or dead-flat, placing one leg of the compasses in the distance set off for the length of the lower-breadth sweep, and extend the other to the spot which terminates the breadth in the side line; thence describe a circle downwards, which will intersect the spots set off on the upper diagonal lines, letting it pass as low as convenient; now fix one leg of the compasses in the centre of the floor-sweep; and the other in the spot set off on the diagonal next to the floor-head, and describe a circle, letting it intersect as many of the spots on the diagonals as it will; then, draw a curve passing from the back of the lower-breadth sweep, through the spots on the diagonals, down to the back of the floor-sweep; and, from the back of the floor-sweep, let another pass through the spots on the lower diagonals to intersect the upper part of the rabbet of the keel; the midship-timber will then be formed below the breadth; and, by proceeding in the same manner with the rest of the timbers, they may all be formed below the lower height of breadth.

Now proceed to form the timbers above the lower height of breadth, where the timbers already drawn intersect the lower height of breadth lines; square them up to their corresponding upper height of breadth lines, and thence set off the length of the upper-breadth sweeps; then fix one leg of the compasses in the spots set off for the upper-breadth sweeps, and the other leg in the line squared up; whence describe a circle upwards: then, from the sheer-plan, take off the heights of the top-timber line, and set them off in the body-plan, drawing horizontal lines, on which set off the top-timber half-breadths, taken from their corresponding timbers in the half-breadth plan.

Next, by drawing curves passing from the back of the upper-breadth sweeps so as to intersect the toptimber half-breadths, the timbers will be formed from the keel to the top of the side. The upper end of the timbers will be determined by taking the heights of the upper part of the topside above the top-timber line, and setting them off above the top-timber line on their corresponding timbers in the body-plan. The lower part of the timbers are ended at the rabbet of the keel, which must be described in the following manner:

Having the keel drawn in the body-plan, by setting off from each side of the middle line half its siding, and its depth below the upper edge of the rabbet, set the compasses to the thickness of the bottom, which is four inches; fix one leg where the line for the thickness of the keel intersects the base line; and, with the other, describe the arch of a circle to intersect the keel line and the base; then, fix one leg where the arch already described intersects the side of the keel, and, with the other, describe an arch from where the keel intersects the base, till it intersects the other arch; then, from the intersection of both arcs, draw a straight line to the intersection of the keel and base line, and another line to the intersection of the lower arch with the side of the keel, by which the rabbet of the keel will then be described in midships; therefore, all the timbers in the midship part of the ship, which have no rising, terminate where the upper edge of the rabbet intersects the base line; but, when the timbers begin to rise, the lower part of them will end in the centre of the rabbet, that is, where the two arcs intersect each other.

Those timbers which come near the after end of the keel, must be ended by setting off the half breadth of the heel at the post, in the half breadth plan, and describing the tapering of the keel; then, at the corresponding timbers, take off the half breadth of the keel, and set it off in the body plan; then proceed as before to describe the rabbet, letting every timber end where the two arcs for its respective rabbet intersect.

The timbers being now formed and ended, proceed to draw in the side counter, or stern timber; take the height of the wing transom, lower counter, upper counter, and top-timber line, at the side, from the sheer plan, and transfer them to the body plan, drawing horizontal lines at those heights; draw in likewise two horizontal lines spaced equally between the wing transom and lower counter, and one spaced equally between the upper counter and the top-timber line in the sheer plan, and transfer them to the body plan.

Then, where the aftside of the stern timber at the side intersects the wing transom at the side, in the sheer plan, square it down to the middle line in the half-breadth plan; square down also the knuckle or touch of the upper and lower counter, and likewise where the stern timber intersects the two horizontal lines drawn between; and, where the stern timber intersects the horizontal line between the upper counter and top-timber line; then, having those lines squared down to the half breadth plan, you must proceed to form curves in the half breadth plan for the shape of the body at every one of those heights.

In order to which, begin with the horizontal line representing the height of the wing transom in the body plan, lay a strip of paper to that line, and mark on it the middle line, and likewise the timbers, 38, 36, 34, and 32, transfer it to the half breadth plan, fitting the spot marked off on the paper, for the middle line, well with the middle line of the half breadth plan; and, setting off the half breadths on their corresponding timbers, 38, 36, 34, and 32; then draw a fair curve to pass through the spots set off, and to intersect the line squared down from the sheer plan. Then proceed, in the same manner, with the horizontal lines at the height of the counters, between the lower counter and wing transom, above the upper counter and top-timber line; and, from where the curve so drawn in the half breadth plan intersects the lines that were squared down from the sheer plan, take the distance to the middle line, and set it off on their corresponding lines in the body plan; now, by drawing a curve to pass through the several spots so set off, the stern timber will be described in the body plan *.

The round up of the wing transom upper and lower counter, may now be taken off from the sheer draught, and set off at the middle line above their respective horizontal lines in the body plan, by which their arcs or round-up may be drawn in. The round-aft of the wing transom may also be taken from the sheer plan, and set off at the middle line, abaft the line squared down for the wing transom in the half breadth plan, by which the arc or round-aft of the wing transom will be described.

* These lines are to be drawn only in pencil, and rubbed out when the side counter timber is formed. Consequently they do not appear on our Sheer-draught; because, if kept in, they would have confused the draught. But they are all accurately represented in plate 34, containing the laying-off of the side stern timber.

The after body being now completely formed, proceed to the formation of the fore-body in the same manner. The particulars which differ from the former, may be described as follow :

The heeling of the foremost timbers must be considered, as the ending of them is on the stem, and consequently differs from those in the after body ; draw a line in the body plan distant from the middle line half of what the stem is sided. Then, take the height in the sheer plan where the timber (which is required to be ended) intersects the lower part of the rabbet of the stem, and set it off on the line before drawn in the body plan, there making a spot ; then, with compasses, take the distance in the sheer plan from where the timber intersects the lower part of the rabbet of the stem, to the intersection of it with the upper part, and fix one leg of the compasses in the spot already made in the body plan, and, with the other, describe a circle, keeping the compasses at the said distance ; and the timbers may then pass over the back of the circle so described ; then, by applying a small square to the timber, and letting the back of it intersect the spot set off for the lower part of the rabbet, the lower part of the rabbet will be described, and likewise the ending of the timbers.

The foremost timbers should also be considered at the head, as they also differ very much in that part from those of the after body ; because, in consequence of the ship's carrying her breadth so far forward at the top-timber line, (being nearly as broad forward as in midships,) it occasions the foremost frames to fall out at the head beyond the main breadth, from which they are called *knuckle timbers*. To describe them, proceed as follows :

The height of the top-timber line being set off in the body plan, set off upon it the top half breadth taken from the half breadth plan ; and, at that place, draw a perpendicular line ; then, from the sheer plan, take the height of the top of the side, and set it off on the perpendicular line in the body plan ; likewise take the breadth of the rail at the top-timber line, in the sheer plan, and set it off below the top-timber line, at the perpendicular line in the body plan, by which will be determined the straight part of the knuckle timber to be drawn ; then, from the last mentioned spot, let a curve pass through the spots set off for the timber, down to the upper breadth, and the whole knuckle timber will then be formed, by which it will be seen that those timbers forward will fall out beyond the main breadth with a hollow, contrary to the rest of the top-side which falls within the main breadth with a hollow.

The after and fore body being now completely formed, we may proceed to draw the water lines on the body plan, from which they must be described on the half breadth plan, in order to prove the fairness of the bodies.

In this draught the water lines are all represented parallel to the keel ; their heights, therefore, may be taken from the sheer plan, and transferred to the body plan, drawing horizontal lines, by which the water lines on the body plan will be represented as marked wat. 1, wat. 2, &c. ; but, in ships that draw more water abaft than afore, the water lines will, consequently, not be parallel to the keel ; the heights must then be taken at every timber in the sheer plan, and set off on their corresponding timbers in the body plan ; and, drawing curves to pass through the different spots, the water lines will be thereby represented in the body plan.

Now, take the distances from the middle line to where the water lines intersect the different timbers in the body plan, and set them off from the middle line on their corresponding timbers in the half breadth plan, where the water lines in the sheer plan intersect the fore part of the rabbet of the stern post, square them down to the half breadth plan, and upon the lines so squared down, set off the half thickness of the stern post at its corresponding water line, (which may be taken from the body plan, by setting off half the size of the post at the head and the heel from the middle line; and, drawing a line for the tapering of it, where the line so drawn intersects the water lines, will be the half thickness required;) then set the compasses to the thickness of the plank, and fix one leg where the half thickness of the post intersects the line squared down; and, with the other, describe an arc, from the back of which the water lines may pass through their respective spots, and end at the fore part of the half breadth plan, proceeding in the same manner as with the after part.

The aft part of the rabbet of the post may be squared down from the water line to the spot set off for the half thickness of the post, by which the rabbet will be represented; and, in the same manner may the water lines be ended at the rabbet of the stem. The water lines being all described, we shall now be able to see if the body is fair, and whether the timbers require any alteration; if they should, it must be complied with.

The cant timbers of the after body may next be described in the half breadth plan, in order to which we must first determine on the cant of the fashion piece; therefore, having the round-aft of the wing transom represented in the half breadth plan, and likewise the shape of a horizontal line at the height of the wing transom, set off the breadth of the wing transom at the end, which is one foot four inches, and there make a spot on the horizontal line, which is the place where the head of the fashion-piece will come; then, to determine on the cant of it, we must consult the shape of the body, because it must be canted in such a manner as to preserve as great a straightness as is possible for the shape of the timber, by which the latter will be much stronger than if very crooked, for, if very crooked, it would be much cut against the grain; we must also consider the cant, so as to give the timber as little bevelling as possible, by which considerations, the conversion will be very much assisted.

Therefore, let the heel of the timber be set off on the middle line about two feet afore timber 36; and, drawing a straight line thence to the spot set off on the horizontal line for the wing transom, the cant of the fashion-piece will be described, and will be found situated in the best manner possible to answer the before-mentioned purposes.

The cant of the fashion-piece being represented, we may now easily determine on the cant of the other timbers; let timber 29 be the foremost cant timber in the after body, and draw in timber 28 in pencil; then observe how many timbers there are to come in between 28 and the fashion-piece, which you will find to be ten in number, viz. 29, 30, 31, 32, 33, 34, 35, 36, 37, and 38; then, with compasses, divide the distance between timber 28 and the fashion-piece on the middle line, into eleven divisions; proceed then to do the same on the main half breadth line; and, by drawing straight lines from the divisions on the half breadth line to their corresponding divisions at the middle line, the cant timbers of the after body will be represented.

The line drawn for the cant of the fashion-piece represents the aftside of it, which comes to the end of the transoms; but, in order to help the conversion with regard to the lower transoms, there may be two more fashion-pieces abaft the former; therefore, the foremost fashion-piece, or that which is already described in the half breadth plan, only take the ends of the three upper transoms, which are the wing, filling, and deck transoms; the middle fashion-piece takes the four next, and the after fashion-piece the lower ones; therefore, set off in the half breadth plan, the siding of the middle and after fashion-piece, which may be thirteen inches each; then, by drawing of lines, parallel to the foremost fashion-piece, at the aforesaid distance from each other, the middle and after fashion-piece will be represented in the half breadth plan.

The fashion pieces and transoms yet remain to be represented in the sheer plan; in order to which, determine on the number of transoms required; these, for so large a buttock, may be seven in number below the deck transom. Draw them in pencil, beginning with the wing, the upper side of which is represented by a horizontal line at its height; set off its siding below that, and draw a horizontal line for the lower edge.

The filling transom follows, which is merely for the purpose of filling the vacancy between the under edge of the wing transom and upper part of the deck plank; therefore it may be represented by drawing of two horizontal lines for the upper and lower edges, leaving about two inches between the upper edge and lower edge of the wing transom, and four inches between the lower edge and the gun deck plank. The deck transom must be regulated by the gun deck, letting the under side of the gun deck plank represent the upper side of it, and setting off its siding below that, the under edge may be drawn in also; the transoms below the deck may all be sided equally, which may be eleven inches; they must also have a sufficient distance between them for the circulation of air to preserve them, as those timbers are more difficult to shift than any others in the ship; therefore, set them off so to have about three inches distance between each; and, by drawing horizontal lines at their different heights, they will be represented.

The transoms being now drawn in pencil, we must proceed to find the length of them as they appear in the sheer plan, in order to draw them in ink; we must, therefore, describe the thwartship appearance of the fashion-pieces as they appear in the sheer plan, by which the length of the transom will be determined.

The foremost fashion-piece may be first described, as that reaches above the upper transoms; in order to which, draw in the sheer plan a sufficient number of horizontal lines; or, as the water lines are horizontal they will suffice, only by drawing one horizontal line between the upper water line and the wing transom, and one above the wing transom at the height you intend the head of the fashion-piece should run, which may be from three to five feet; then take the heights of those two horizontal lines and transfer them to the body plan; and then run them in the half breadth plan, in the same manner as the water lines; then, where the line drawn for the cant of the fashion-piece in the half breadth plan intersects the horizontal line for the head of the fashion-piece, square it up to the said horizontal line in the sheer plan, making a spot; square up, also, the intersection of the cant line with the horizontal line for the wing transom in the half breadth plan, to the corresponding line at the wing transom in the sheer plan; then, square up where the cant line in the half breadth plan intersects the horizontal line below the wing transom; and, also, the water lines, to their corresponding lines in the sheer plan. Now, by drawing a curve to pass through the several spots to set off, the thwartship view of the foremost fashion-piece will be described, as it appears when seen in the sheer plan; in the same manner may the middle and after fashion-pieces be described, observing to let the middle one run up no higher than the under part of the deck transom, and the after to the under side of the fourth transom under the deck; the transoms may now be drawn in ink as their lengths are limited by the lines for the fashion-pieces.

The stern post may now be completed, as the fore side of it has not yet been drawn in, nor the head of it determined. Take, from the dimensions, how much the stern post is fore and aft at the keel, and set it off on the upper edge of the keel, from the line representing the aft side, making a spot; then the head of the post must be determined, which must run high enough to admit of the helm port transom and the tiller coming between it and the upper deck beams; reserving about three inches from the underside of the tiller to the helm port transom, and two inches between the upper side of the tiller and under side of the deck beams. The head of the stern post, therefore, will be two feet nine inches above the wing transom. Draw a horizontal line for the head at that height, and set on it the size of the stern-post at the place taken from the dimensions; then, drawing a straight line thence down to the spot set off on the keel, (observing not to draw the line through the transoms, as it will only appear between them) the fore side of the stern post will be described, and the stern post completed.

The inner post may be drawn by setting off its dimension fore and aft from the stern post, and drawing a straight line as before, continuing it no higher than the under side of the deck transom.

The cant timbers of the after body being described, and every part also which depended on them, we may now proceed to the cant timbers of the fore body; in order to which, we must first determine on the foremost and aftermost cant timber, and likewise on the cant of the foremost one; therefore, under the considerations explained with respect to the after body, the foremost cant timber will extend as far forward as to be named Y. The cant on the middle line may be one foot six inches abaft square timber U; and, on the main half breadth will line with X, in which situation the line may be drawn for the cant; the aftermost may be timber P. All may now be drawn in, proceeding as before described for those of the after body, which is spacing them all equally between the cant timber Y, and the square timber O, both on the main half breadth and middle line; and, drawing lines from the spots on the main half breadth line to their corresponding spots on the middle line; observing to let them run out to the top-timber half breadth line, where it comes without side the main half breadth line.

The hawse pieces must next be considered in the half breadth plan, the sides of which may be parallel with the middle line. Take the siding of the apron, from the dimensions, which may be about four inches more than the stem, (unless the rabbet be in the middle of the stem, then the siding of the apron can be no more than the stem;) set off one-half of it parallel from the middle line, drawing a line from the main half breadth to the foremost cant timber, which will represent the foremost edge of the knight head; from that set off the siding of the knight head, from the dimensions, and draw in the aftside of it: the hawse pieces, which are four in number, may then be drawn, by setting off their sidings, from the dimensions, parallel to the knight head, and from each other; then, by drawing straight lines from the main half breadth line to the foremost cant timber, they will be represented.

In the next place, describe the hawse holes, which should be placed in such a manner as to wound the hawse pieces as little as possible; they may therefore be placed so that the joint of the hawse pieces shall be in the centre of the holes, by which they will only cut half the hawse pieces; whereas, were they placed between the joints, they would cut off the hawse pieces. Take from the dimensions the size of the hawse holes, and set off the foremost one, or that next to the middle line on the joint between the first and second hawse piece, then set off the other on the joint between the third and fourth hawse piece, and, by drawing lines across the main half breadth line at their respective places, they will be represented in the half breadth plan. Or, to avoid wounding the hawse pieces, have middle pieces sided six inches less than the holes; then, by cutting three inches on the sides of the hawse piece between the holes, those hawse pieces, being sided more, are wounded proportionably, but little.

The hawse holes should now be represented in the sheer plan; in order to which, determine on their place there; in the eighty-gun ship they are placed between the cheeks; therefore set off their diameter between the cheeks; therefore set off their diameter between the cheeks, leaving sufficient substance for the bolster; and, drawing lines parallel to the cheeks for their upper and lower part; then, to determine on their situation agreeably to the half breadth plan, set off the thickness of the inside and outside plank, the fore and aft way; we must then square up, from the half breadth plan, where they intersect the inside and outside plank at the main half breadth line, to the lines drawn between the cheeks, in the sheer plan; which will give the true situation the fore and aft way; then, by drawing them circular, agreeably to the spots set off, they will be represented as they appear ticked in the sheer plan.

The apron may be drawn in the sheer plan, setting off its size fore and aft from the stem, letting it come down so as to scarph about two feet higher than the foremost end of the fore foot, by which it will give shift to the scarphs of the stem, and so continued up to the head of the stem.

The cutting down should next be drawn; therefore take, from the table of bodies, the different heights there expressed, and set them off from the upper edge of the rabbet of the keel on their corresponding timbers in the sheer plan; then, by drawing a curve to pass through the spots set off from the inner post aft to the apron forward, the cutting down line will be represented.

To describe the limber-strake, draw a line parallel to its thickness, as in the dimensions, above the line representing the cutting down, which is eight inches. Thus will the limber-strake be described, from which the depth in the hold is always measured.

It here becomes requisite to observe that the limber-strake, keelson, dead-wood knee, and stemson, are not represented in the sheer draught, as they would interfere too much with the other lines in that plan. But they may be seen very clearly represented in the draught of the Inboard Works, plate 4.

Proceed now to draw in the keelson, by taking the depth of it from the dimensions, which is one foot seven inches, and setting it off above the cutting down line; then, by drawing a line parallel to the cutting down, the keelson will be described.

The cutting down line being described, we are now enabled to represent the knee of the dead wood abaft timber 28, being the after floor timber: set off the siding of the floor abaft it, and erect a perpendicular line in the sheer plan, which will terminate the foremost end of the after dead wood; then, the fore and aft arm of the knee may be half the length of the whole dead wood, and the up and down arm reach to the under part of the lower transom. The whole knee must be placed in such a manner that the upper piece of dead wood shall bolt over it, and be of as much substance as the knee itself; therefore, the cutting down line representing the upper part of the dead-wood, the knee must consequently be placed its whole thickness below that line.

Next draw in the sternson knee, which fays upon the upper piece of dead-wood and scarphs with hook and butt, about twelve feet long, into the after piece of the keelson. The up and down arm extends up to the upper side of the deck transom also.

The Stemson fays against the Apron and runs up so as to tenon into the under side of the upper deck hook and the heel, and scarphs into the fore end of the keelson with hook and butt three feet long. The dimensions may be found in the table.

The Plan of the Head may be drawn in by continuing forward the middle line of the half breadth plan. Upon it, square down the foreside and aftside of the figure from the sheer plan; and, upon those lines, set off half the siding of the figure from the middle line, as in the table of dimensions.

Then draw the main rail to its half breadth appearance thus: set off the siding of the after end of the main rail from the outside of the plank at the top-timber half breadth, at the foreside of the beak-head; and, also, the siding of the fore-end from the outside of the figure; the fore-end being squared down from the fore part of the hair bracket in the sheer plan; observing, however, to add to the siding the thickness of the lining: then, by drawing straight lines to those spots, the half breadth plan of the main rail will be described.

Square down, from the sheer plan, the head timbers where they intersect the under side of the main rail to the middle line of the half breadth plan: likewise, square down the fore and aft sides of the knight-head, and run the half-breadth line at the upper side of the beak-head and thickness of the outside plank.

Square up, from the middle line of the half breadth plan, the head beam, so as to let aft about two inches upon the stem; and, square up, likewise, the cross-piece at the foremost head timber, to which the main rail is secured by knees on the aftside.

Parallel to the middle line, draw in half the diameter of the bowsprit; then draw the fore and aft carling, rather without the bowsprit, so that the gammoning may lead down clearly.

The flat of the head, which is composed of ledges, may next be drawn, and the boomkins represented thus: Square down, from the sheer plan, the centre of the foremast, at the upper deck, to the middle line in the half breadth plan; whence draw out a line forming an angle of 36 degrees with the said middle line; and, upon it, set off half the length of the fore yard forward; then square it down to the middle line of the half breadth plan; draw in the boomkins parallel to the line which forms the angle abovementioned, and they will come nearly over the middle head-timber, the heels resting against the knight-head; the length may be regulated by the line squared down from the fore yard arm.

The seats of ease may now be drawn. Those for the officers are in the round-houses ; those for the seamen are two on each side afore and abaft the boomkins, and one on each side next the round-houses. Sometimes, instead of the latter, cisterns are fitted, to wash in occasionally. The rest of the head is then framed with ledges as before observed.

The sheer draught is now completely formed, and every part thereof represented, as also the body and half breadth plans, from which the ship may be laid down in the mould loft, and likewise the whole frame erected. To complete the draughting, there now remains to draw a profile of the inboard works, Plans of the Decks, &c. ; but, as the use of the diagonal lines in the body plan has not yet been sufficiently explained, we shall first proceed to treat of them in the next section.

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§ 4. CONTAINING AN EXPLANATION OF THE NATURE AND USE OF THE DIAGONAL LINES IN THE BODY PLAN.

The diagonal lines in the body plan are given in the tables of bodies, merely for the purpose of forming the body therefrom ; but, after the body is formed, they are of very principal use ; as, at their stations, the ribbands and harpins which keep the body of the ship together whilst in her frames, are all described, and the heads of the different timbers in the frame likewise determined ; consequently it follows that a particular explanation of them is necessary, as they are the diagonal lines or ribbands that are used in the laying-off of the ship : We shall therefore begin with

The Lowermost, or number 1, which is termed the *Lower Diagonal*, at which place the lowest bevellings of the timbers are taken ; its situation is generally in the middle between the keel and floor ribband.

The Second Diagonal is placed in the midships, about eighteen inches in small, and two feet in large ships, below the floor head ; it is the station where the floor ribband is placed in midships, and likewise the floor harpin forward ; there is also a bevelling taken at this diagonal, all the way fore and aft, from which it is termed the *Floor Ribband.*

The Third Diagonal terminates the length of the floors, and is therefore called the diagonal at the Floor Head ; there are likewise bevellings taken at this diagonal to as far forward and aft as the floor extends. The placing of this diagonal is of the utmost consequence to the strength of the ship, it being so near to that part of the bilge which takes the ground, that it, consequently, is always liable to the greatest strain. It should therefore be placed as much above the bearing of the body in midships as can be conveniently allowed by conversion of the timber ; but, afore and abaft, it is not of so much consequence.

The Fourth Diagonal is placed in the middle between the floor head and fifth diagonal, at which place a ribband and harpin are stationed for the security of the first or lower futtocks, from which it is termed the First Futtock Ribband. There are also bevellings taking at this diagonal all fore and aft, which being part of the body where the timbers most vary, occasion them to be the greatest bevellings in the whole body.

The Fifth Diagonal terminates the heads of the first futtocks, and is therefore called the First Futtock Head; it should be placed at a convenient distance above the floor head, in order to give sufficient scarph to the lower part of the second futtocks, which is particularly observed in the tables of dimensions. Bevellings for the timbers are likewise taken at this diagonal all fore and aft.

The Sixth Diagonal, called the Second Futtock Ribband, should be placed in the middle between the first futtock head and seventh diagonal, at which place the ribband and harpin are stationed for the support of the second futtocks. Bevellings are also taken at this diagonal all fore and aft.

The seventh Diagonal called the Second Futtock Head, terminates the second futtock heads from the fore to the aftermost floors, and afore and abaft them it terminates the double futtock heads in the fore and after cant bodies; it should be placed in midships as much above the first futtock head, as the first futtock is above the floor head, by which it gives the same scarph to the lower part of the third futtock as the first futtock does to the second: there are bevellings also taken all fore and aft at this diagonal.

The Eighth Diagonal is the station for the ribband and harpin which supports the third futtocks, and is therefore placed between the second futtock head and ninth diagonal; it is also a bevelling place, and is termed the Third Futtock Ribband.

The Ninth and last Diagonal, called the Third Futtock Head, is placed at the same distance above the second futtock head, as that is above the first, and it terminates all the heads of the third futtocks excepting such as come under lower deck ports. The latter must run up to the under part of the ports, as no short timbers should, by any means, be admitted under the ports, which require the greatest strength that is possible. This diagonal is a bevelling place for the heads of the third futtocks.

The fourth futtock heads are terminated by the under part of the upper deck ports all fore and aft, and a ribband is placed fore and aft a little below the height of the lower sills of the upper deck ports. Another is placed in like manner, at the lower deck ports, and one at the top-timber line, which, with the ribbands and harpins before mentioned, keeps the whole body of the ship together, and in its proper form and shape.

It must be observed, that the diagonal lines laid down in the table of bodies, will not correspond to what has been said upon the diagonals in this chapter, as they were drawn discretionally upon the body for the purpose of giving the true dimensions of it; the student must therefore, when he has his body drawn in fair, rub out the first diagonals (which should only be in pencil), and then proceed to draw in the proper diagonals in red ink, strictly adhering to what has been said on the subject.

ADDITIONAL OBSERVATIONS ON THE RISING LINE IN GENERAL.

THE method of constructing the midship floors of some ships, by lengthening the radii afore and abaft, is preferable to the rising line as used in constructing merchant ships of burthen, where the radii of the floor sweeps all fore and aft are of the same length as at the midship bend; because, by this method, every floor from dead-flat is graduated by a larger circle. But this method is not so generally serviceable in laying-off the ship; because, in any ship constructed by the same length of radius, you may venture, so far as the rising line is continued, to lay down the body on the mould-loft floor, without running any ribband or horizontal lines till that part is finished. Again, this method affords a greater assistance; as, by it, the floors may be nearly constructed all fore and aft, but the floors near the midships only can be constructed when the radii of the floor sweeps alter much in their length.

Neither the rising line nor the half breadth of the rising would continue the curves as first constructed if the form of the body were designed to be altered in that part. It is evident, then, that the rising line may be drawn according to the judgment of the artist in the construction of any draught, observing to make it a fair elliptical curve: for much depends in the construction of the lower part of the body, by judiciously narrowing the floor sweep or half breadth of the rising; for, the more parallel it is kept with the middle line the less will be the velocity of the vessel: and, again, the quicker this curve is, the less bearing will the vessel have; and, though it may be supposed, when the rising line is formed, and the half breadth of the rising, it is reasonable to expect a fair draught, yet we cannot be certain of its producing that form of body which we really intend, agreeably to the use which the ship is designed for; unless, by frequently constructing of bodies, we can form an exact idea before we proceed. Therefore we would recommend the young artist to improve himself by drawing those bodies from the dimensions which are constructed by the rising-line, and of different properties, till he forms in his own judgement a perfect idea of this mode of construction. Then, when the draught is finished, the water lines run, and the buttock lines or vertical sections are run all fore and aft on the sheer-plan, some room for alterations may be perceived; then, you may observe whether the rising line, and half breadth of the rising line (or, as it is sometimes called, the narrowing of the floor-sweeps) correspond with that part which you intend to alter. If it be required to make the ship cleaner, lift the rising line, and narrow the half breadth of the rising line; and, where it may be required to make the ship fuller, lower the rising line; which sufficiently proves, that the rising line is as variable as the different forms of the bodies; but, yet it is a very complete method of constructing the lower part of such ships fair, as require some provision, or fullness of body, to assist them when taking the ground. The farther forward and aft the body is assisted by the rising line, the more merit there will be in the construction, and the greater certainty of producing a fair body.

§ 6. INSTRUCTIONS FOR DELINEATING THE DISPOSITION OF ALL THE TIMBERS COMPOSING THE FRAME; LIKEWISE FOR EXPANDING THE BOTTOM AND TOPSIDE, BY WHICH THE LENGTH, BREADTH, AND NUMBER, OF ALL THE PLANKS MAY BE KNOWN, &c.

1. OBSERVATIONS ON, AND INSTRUCTIONS FOR, THE DISPOSITION.

To give the true shift and appearance of every timber in the ship, may perhaps be thought, by some of our readers, to be superfluous; but, as our grand object is, to acquaint the young beginner with every thing interesting in the science, and with the means of calculating every particular required in the erection of a ship, we now proceed to explain the nature and use of a disposition of the frame, as represented in plate 2, and of the planking expanded as represented in plate 3, of this work.

The utility of plans of this description requires but little explanation; as it is evident, upon inspection, that they exhibit the disposition and shift of every timber and every plank used in a ship, and they, consequently, afford the means, before the ship comes on the stocks, of disposing of every piece to the greatest advantage, both with respect to the strength of the ship and to the conversion of the timber; and, moreover, of preparing every piece for its proper situation with the greatest facility.

Without enlarging, unnecessarily, upon these important advantages, we shall now give some instructions for the disposition of the timbers, &c.

With respect to the frame timbers, it is, in the first instance, of the greatest consequence to the strength of a ship, that they should be cut as little as possible by the ports on each deck; and, secondly, that all the timbers designed to make the sides of ports are, or should be, continued if possible, without scarphing, up to the top of the side. Those timbers, however, which lie in the sudden turn of the body, having too great a curvature in their length, and others, which run up to the rough tree rail, &c. having too great a length to be otherwise obtained, must be admitted to scarph, as shewn on the draught of the disposition, plate 2.

In the turn of the body, forward and aft, as the frames are canted, there is the less compass or curvature in them, and the bevellings or angles approach nearer to a square, which is, of course, the more favourable to conversion. The stations of the timbers being kept at the main breadth, in order to give them their proper cant, contract the room and space on the dead-wood, and reduce the heels of the timbers accordingly.

The frame timbers are formed into bends, in the manner that we have already shewn, by the union of first futtocks, second or middle futtocks, third and fourth futtocks, with top-timbers, which are severally joined together and bolted. Sometimes the frame timbers are fayed close together or separated for air; those that are separated have dry pieces of oak fayed between them in wake of the bolts.

By the disposition of the frames, in their several stations, they stand, respectively, one on each side of every gun-deck port, by which the sides of every middle and upper-deck port are likewise provided for. Thus one fourth futtock and one long top-timber will form the side of every gun-deck port in two-decked ships, and the side of every upper-deck port in three-decked ships. A long top-timber and a fourth futtock will, in like manner, make the sides of the middle-deck ports in three-decked ships, and the sides of upper-deck ports in those of two decks.

All ships should be, as we have already explained, as light as possible in their upper works, consistently with the services for which they are intended; and, as the frame should not be incumbered with more short timbers than are absolutely necessary, two short timbers over the ports are sufficient to stand upon the sills, and so spaced as to receive the bolts of the deck standards above.

Those timbers that run up to make the sides of quarter-deck ports, forecastle ports, or to the roughtree rail, should, if possible, be made of timbers standing upon the upper-deck sills over the upper-deck ports. The side along the waist, between the ports, may be filled in with fir timber laid fore and aft, and dove-tail'd into the frames.

The frame will be sufficiently full, and every purpose answered, when timbers are provided to form the gallery doors, and to fill in the quarters from the after frame to the side counter timbers; and, forward, from the foremost frame to the hawse-pieces.

All the timbers in the range of the main and fore channels should run up to the top of the side, and the filling timbers between each frame are all to be equally spaced between the frames; and, all the openings between the range of the chain and preventer bolts are to be filled in solidly with dry oak fillings, as are also those over every gun-deck and middle-deck port, that there may be solid boring in wake of the port-ropes, pipes, and muzzle lashing eye-bolts, also behind iron knees and standards.

All scuttles, row-ports, &c. should be considered in the disposition of the frame, so that the strength may not be reduced.

Having considered the several subjects above mentioned, proceed to take, from the sheer-draught, the keel and its rabbet, likewise the stem and stern-post, with the transoms, and bearding-line of the dead-wood or stepping of the cant timbers; then the midship and side counter timbers; and, next, take off all the ports, the underside of the decks at the side, the plank-sheers, beakhead, and roughtree rails. Then square up, from the half-breadth plan, all the sidings of the cant timbers to their respective lines in the sheer-plan, so that their thwartship appearance may be exhibited in the same manner as the joints. This need only be done in pencil.

From the sheer-draught, the thwartship appearance of the outsides of all the cant timbers may now be transferred to the draught of the disposition. In the same manner may be squared up the thwartship appearance of the knight-head and hawse-piece, which may, likewise, be transferred as the rest.

Beginning forward, we shall now endeavour to make every necessary observation in regular order. First, the hawse-holes may be transferred from the sheer-draught, as we have before shewn; then the height of the heads of all the timbers may be taken, above the base line in the body-plan, and set off above the upper edge of the rabbet, upon their corresponding timbers in the disposition. Curves being now drawn through the spots set off, will shew the heads of each timber in the disposition.

Next, square up in the disposition, the siding of all the timbers between the cant bodies and, as the upper-deck ports are less fore and aft, than those of the gun-deck, the upper part of the frame timbers must be separated at the joint. It is customary, to open the joints of the frames from the side of the keel upwards, having dry pieces of oak fayed between them in the wake of the bolts, as at timber O.

We can now represent every timber; those in the fore square body as at ⊕, and those in the after square body as at (3), having a single timber to shift the floors at (2). Those in the fore cant body as at Q, and those in the after cant body as at 30.

The fourth futtocks, being the longest timbers in the ship, and, from their shape, very difficult to be obtained of the whole length, especially for ships which have much tumble home, or even long enough to run up so as to make the side of the upper-deck ports, particularly forward and aft, the sides of such ports have sometimes been made by the top-timber that comes under the port, by its having been formed with a cast sideways over the fourth futtock and continued upwards, making a whole top-timber: but, in this case, it is necessary to see that the cast be fairly grown, and not grain-cut; also, that it be so disposed as not to be wounded too much by letting out the port-sills: for, was the top-timber, as represented at frame S, in the plate, to cast so as to make the sides of both ports, it would not be so strong as otherwise, although bolted to the fourth futtock; because, as is evident, we should lose a shift: for, not only would that timber have run up to the top of the side, but the top-timber under the port, with the cast, would run up also. It is consequently much the best way. These methods have, however, been found very defective, and are attended with particular disadvantage, as the difficulty of getting fourth futtocks, even when sided straight, and much more so when cast; because, without a very particular growth, they would be grain-cut in the cast; and, consequently, have very little strength.

The method, therefore, that we would recommend to be adopted when such fourth futtocks cannot be obtained as will run up to the top of the side, is, to scarph them together with a hook and butt, as at fourth futtock K, and at M, in the plate; giving shift to the port and each other; or, if preferred, the side scarph as represented at fourth futtock D.

The third futtocks, that come under the gun-deck ports, are to be continued upwards to the underside of the sill, as at W, R, N, &c. But, when the third futtocks, owing to their great compass, cannot be gotten so long, they must be scarphed as at I, observing always to get them longer than the regular shift.

The port-sills may next be drawn: the upper sills deepest where the preventer bolts are likely to come. Then the blocks through the side may be represented, that long timbers may not be provided, and afterwards cut asunder by those blocks; namely, the main-tack block, between D and F; the fore-sheet block, between 2 and 4; and the main-sheet block, between 30 and 32.

The foreside of the side counter-timber may next be drawn in from the dimensions, and the gallery doors set off from the sheer-draught; then the sills and all the timbers necessary to frame the quarters abaft frame 38.

Having provided for all the ports, &c. thus far, it should next be contrived that the timbers which run up aft and forwards to make roughtree timbers, timber-heads, or the sides of quarter-deck and forecastle ports, should be those short timbers that stand upon the upper sills of the upper-deck ports; and, for roughtree timbers, those over the quarter-deck ports; as it should be the utmost care of every constructor to design every timber to the shortest length admissible; as, in a disposition of this kind, he has every opportunity of so doing; and likewise of pointing out, and converting to the best advantage, the most scarce and valuable timbers.

Lastly, the section abaft the stern-post, in the plate of the disposition, represents the thwartship appearance of the air-funnel in the opening of frame 10. These funnels have been found very convenient for carrying off the foul air from between decks, and may be placed wherever convenient, between the openings of the timbers; so that there be no obstruction; but, that the air may pass upwards freely either to the undersides of the sheer-strakes, in the waist, and undersides of the lodging-knees elsewhere; openings being cut through the inside stuff, about two inches deep, and as much fore and aft as the openings. Advantage of the largest openings should always be taken for their admission.

All that is required in fixing the funnel, is one sill, let in between the timbers at the underside of the gun-deck lodging knee, or upper deck in frigates, &c. and another at the underside of the sheer strakes in the waist, or underside of the quarter-deck or forecastle lodging knees, as they are shewn in the section. The openings may then be paid with pitch, tar, or rosin.

EXPANDING THE BOTTOM AND TOPSIDE.

BEFORE we proceed to the expansion of the planking, it becomes necessary to make some remarks on planking in general; as the planking of a ship is a branch so very material, that, unless it be judiciously performed, it will inevitably be very injurious to, or subversive of, those good qualities that might be expected from the superior construction of the ship. The planking ought, therefore, to be particularly well performed; as, in the joining, or proper shifting, fastening, and caulking, the goodness of every part of the materials for that purpose should, consequently, be very carefully inspected.

The length of plank is a very great object to be considered; and, in the shifting, it is principally to be observed: for, if it cannot be worked up to the wales with the length begun with, (that is, the regular shift kept up,) it will make very bad work, and not be so strong upwards as below. It is allowed, and hath generally been found to answer, that if three whole planks be wrought between every two butts, and all the butts overlaunch, or be in distance from each other, six feet, the planks will be only twenty-four feet long, and the work reckoned very good. We may, however, have a very bad shift, and yet have three strakes between every two butts on the same timber: that is, when the butts rise one above another in a regular manner, like steps; for, as the upper butts, or those in the topside, are the most likely to give way, all below would be inclined to follow; for, if the ship begins to break her sheer amidships, it is most probable that the butts afore and abaft would yield proportionably; therefore, let one of the butts between have a double shift, or extend twelve feet; then will the stepping of the butts, which we have mentioned, be prevented, and the planks be twenty-four feet long. As the work will thus be sufficiently strong, this is the rule which is generally followed for ships of every class in the royal navy. But, as oak plank, having sufficient breadth at the tops in that length, has become exceedingly scarce, merchant-ships have the plank shifted of various lengths, according to its thickness, as may be seen by referring to the table of dimensions hereafter.

The Wales must be wrought of such lengths, and the butts shifted, so as to give the strongest shift to the ports and each other; and, to assist conversion, may be wrought anchor-stock, or still more so, by being wrought top and butt. When the wales consist of four strakes, they have a fair seam in the middle.

In determining on the shift of the wales, some of the midship pieces should have a three-port shift, that is, should overlaunch three ports, being careful in large ships to make one butt answer for the pump dale scupper.

If the wales are to be wrought in three strakes, let the two lower strakes be worked top and butt, and the upper strake of a parallel breadth.

The Thickstuff, or diminishing strakes, from the lower edge of the wale to the thickness of the bottom plank, being of English oak, is wrought top and butt; and should be shifted from the butts of the wales to the regular lengths of the bottom plank as soon as possible.

The Plank of the Bottom is English oak plank, as low as the light-water mark; and, below that, may be East-country plank of the best quality. The English plank is worked top and butt to twenty-four feet lengths at least. Now, to break the shift, so as to work East-country plank to advantage, requires care; for, as just observed, the general shift of English plank is twenty-four feet, whereas East-country plank is from thirty to fifty feet; consequently, the best way is, to work a double shift at first, or one of forty-eight feet in length. It rarely happens that the shift is broken from English plank to East-country plank without introducing two planks between two butts on the same timber in some places; and, it may be admitted, owing to the superior length. Be careful, in shifting the East-country plank, to keep the shift as nearly equal as possible, not being confined to butt on one timber; but, to make an advantage of drawing the butts having no less than six feet shift.

East-country plank, from ten to eleven inches broad, is wrought with fair or parallel edges, excepting forward and aft; for, it must be observed always to have English oak plank for the foremost and aftermost shifts. Four to six strakes next the keel may be of elm or beech. The edges, and butts of those in East-India ships, are rabbeted close; and fine flannel, dipt in tar, is put between.

Let it also be observed, in shifting the butts, to keep them clear of the scarphs of the keel; and, likewise, that no butt is placed under the pumps.

In planking the foremost end of the bottom, the breadth of the strakes must be considered, and also the shape of the bow, that every strake of plank may be brought into the stem; and every plank should be kept from snying as much as possible. But, in full-bowed ships, such as have long floors, and a round or full harpin, it would be impossible to bring every strake to the stem without too much sny. It is therefore customary to work, in the bow of such ships, a steeler next under the wale; and, at every fourth or fifth strake next under it: by which means all the strakes that come to the stem will be of sufficient breadth. In order to take the sny out the more, bring the steeler well forward; the more so the better. In most ships a drop strake, or steeler, under the wale abaft, assists the planks very much in working at that sudden part of the ship.

To produce fair edges and facility in working the planks, let the after ends of those near the keel be worked broad, indeed they cannot be worked too much so, in order to bring their edges straight, and out of winding.

The Plank of the Topside is generally wrought in parallel breadths; therefore it had better not be more than eight inches broad, or thereabouts. The topside being cut by the ports, drifts, &c. requires the greatest strength to be given to it in shifting the plank; as no butt should be placed over or under a port unless there are two planks between. The planks in wake of the main-mast should have a three-port shift. The others, afore and abaft, may have a two-port shift. As it is rather stronger, to butt between the ports, it may be allowed sufficient to have a shift of five feet six inches where a plank comes between; or, five feet where two come between. But there should not be less than six feet shift where no plank comes between. The channels and sheer-wales, in large ships, should work down to the stops of the ports in midships; and, where the sheer lifts forward and aft, should work down to as many ports as may leave sufficient stop, and afford wood to receive the port-hooks, letting the wood so worked down be continued six inches each way beyond the stops of the ports: thence snape back about nine inches; but, by all means, let planks run through, if they hold but five inches after the stops are cut, so as the hooks will clear the seam; for planks, however broad, working down to the ports, make that part no stronger than any other.

Forward, in wake of the hawse-holes, the planks should be so wrought as to have the seam come in the middle of the holes; and care must be taken that no seams come behind the cheeks.

The Sheer Strakes, as they are the greatest strengtheners of the topside, should have their butts disposed with the utmost care, in order to produce the greatest strength between the drifts, and give the very best shift to each other. They are wrought of parallel breadths, with hook and butt scarphs, about four feet long, between the drifts. Those afore and abaft may be square, especially behind the channels, which must be of English oak. The others, owing to their great lengths, must be of East-country plank.

Shifting the butts of the inside planking requires this consideration; that the strings along the waist, and the upper-deck clamps and spirkittings, should give shift to the butts on the outside.

All clamps and spirkittings above the lower gun-deck should have three-port shifts in midships. All clamps should be wrought with hook and butt scarphs, about four feet long; spirkittings should be wrought top and butt, or anchor-stock, so that no butt shall come behind the riders. One butt is to come in wake of the pump dale scupper.

Clamps of two and three decked ships, above the gun-deck, are sometimes wrought in two strakes. Spirkittings are wrought in three strakes, and tabled into each other.

The clamps of the lower deck cannot be wrought towards the after part of the ship agreeably to the range of the deck, so as to admit of the beam's coming home to the timbers, as it would be found to wound them too much, or produce too great a sny; therefore, the clamps must lift quite aft, with an easy flight, and some of the after beams, of course, must come on the clamps.

TO EXPAND THE BOTTOM AND TOPSIDE.

The expanding of the bottom and topside, upon paper, so as to be certain of the lengths and breadths of the planks, together with the mode of disposing of the butts to the greatest advantage, although attended with some trouble, is much more advantageous than trusting to shifting them on the ship's side; for, when the ship is planking, it is necessary to girt the body in a number of places, in order to see what number of strakes the bottom will require, that the planks may be worked of an equal breadth, and fairly diminished forward and aft. To do this, with precision, stageing and much trouble is required. But, having the bottom and topside expanded before you, upon a plane, and knowing the general lengths that your planks will work to, you can more conveniently shift the butts, according to the foregoing directions, or alter any one where the length cannot be obtained without difficulty, or without making bad work; which could not be so easily performed on the side of the ship.

The bottom may be expanded by the horizontal or water lines; but, the eighty-gun ship's bottom, as represented on Plate 3, is expanded by the ribband lines; as the latter are square from the body, or nearly so, and nearly in that direction in which the planks of the bottom are wrought. The ribbands may, likewise, be represented, by which means you will perceive what number of planks may be wrought before they need be shifted.

Now, from the sheer-draught, Plate 1, may be taken the stations of all the timbers, and the lower edge of the rabbet of the keel from the aftside of the rabbet of the stern-post to as far forward as the rabbet continues straight; likewise the scarphs of the keel; all of which are to be set off on the plan of expansion, as shewn on the plate, to intersect the said straight line. Then, to expand the square bodies, transfer the heights of the upper and lower edge of the main and channel wales, the sheer strakes, upper and lower sides of all the ports, the height of the decks at the side, and underside of the planksheer from the sheer-plan, (Plate 1.) to the body-plan. Likewise draw the ribbands by which the ship is to be framed, and which are not shewn in the first draught, across the body-plan. These are, however, clearly exhibited in the first and second plates of Laying-off (Plates 32 and 33). The ribbands, wales, &c. are now to be drawn upon the half-breadth plan; which, being done, apply to those lines narrow slips of paper, confining them by needles, from ⊕ forward and thence abaft; marking, upon each slip of paper, the station of every timber and its respective ribband, &c. as girted.

In the same manner girt the timber ⊕ in the body-plan (Plate 1) from the inside of the rabbet of the keel to the top of the side; then, mark upon it the uppersides of all the ribbands, heads of the timbers, upper and lower edges of the wales, and ports; likewise, the decks at the side, and underside of the planksheer. Then square up the station of ⊕, as shewn on Plate 3; and, upon that line set up the middle of the rabbet, to which spot fix with a needle the spot on the slip of paper that girted ⊕, and is marked for the inside of the rabbet of the keel, laying the edge fair with the line ⊕ squared up; now, upon that line, mark off from the said slip the upper sides of all the ribbands, the heads of the timbers, upper and lower edges of the wales, ports, &c. In the same manner must we proceed to girt every square timber in the body-plan (Plate 1), marking thereon the name of its respective timber. Then fix the point marked for the middle of the rabbet of each girt, to the middle of the rabbet of its respective timber (Plate 3).

Now fix the girt of each ribband to its corresponding height as marked on ⊕; then stretch each girt, seeing that it does not pucker, in such a manner that the stations of the timbers, as marked on the girt of the ribbands, &c. and the corresponding heights of the ribbands as marked on the girt of each timber, exactly agree, confining them with a needle in that situation. At the intersection of each, make dots, which will shew the expanded heights and lengths of all the ribbands, &c. in the square bodies. Fair curves may then be drawn through all those dots, which will represent the square bodies expanded.

TO EXPAND THE FORE CANT-BODY AND HAWSE-PIECES.

TRANSFER the before-mentioned heights from where they intersect the thwartship view of the fore cant-timbers in the sheer-plan (Plate 1.) to their corresponding timbers as shewn in the third plate of Laying-off (Plate 34); and then continue, downwards, the heels of the said cant-timbers as low, and as much within, the half siding of the stem, as the rabbet, when taken out, may be supposed to cut into the side of the stem. Likewise continue downwards the joints of the cant-timbers in the sheer-plan (Plate 1.) till they intersect the middle of the rabbet of the keel and stem. Then, with narrow slips of paper, as before, girt the several cant-timbers in the fore body, as shewn in the third plate of Laying-off (Plate 34.), marking thereon the heel, where it cuts the inside of the rabbet, the bearding line, the heights of all the ribbands, or harpins, as levelled out, the lower and upper edges of the wales, the ports, &c.; and, on the foremost cant-timber, the heights of the heels of the hawse-pieces, marking on each slip or girt the name of its respective timber. Then, with other slips of paper, girt round each cant-ribband, or harpin, in the half-breadth plan, as shewn on the third plate of Laying-off (Plate 34.); and mark thereon the joint of square timber O, and the joint of each cant-timber where it is squared up from the horizontal to the cant ribband: likewise mark the intersection of each hawse-piece, as squared up from the horizontal to the cant ribbands; also where the bearding line intersects the cant ribband, and where the ribband ends in the rabbet. The girt at the wales, port-sills, and top-breadth, must also be taken, and respectively marked on each girt or slip.

Now girt another slip of paper round the curve representing the middle of the rabbet of the stem and keel (Sheer-plan, Plate 1.), marking thereon the square timber O, and the joints of all the cant-timbers where they intersect that line; mark, also, the height of all the ribbands, or harpins, the upper and lower edges of the wales, ports, &c. beak-head, and upper part of the stem.

Square up from the half-breadth plan, as shewn in the third plate of Laying-off (Plate 34.), where the heels of the hawse-pieces intersect the joint of cant-timber y to its thwartship appearance in the sheer-plan; and, then transfer those heights to cant-timber y in the body-plan; prior to taking the girt of that timber: as those points will give the heels of the hawse-pieces when expanded, as shewn in Plate 3.

The slips or girts of the harpins are then to be stretched as before (Plate 3.), keeping the spot of square timber O to its respective ribbands, already expanded on that timber. Then stretch the girt taken round the curve of the stem, fixing its spot O at timber O, as shewn in Plate 3.; then, confining the heels of the cant-timbers to their respective spots on the curve of the stem, move the whole together, without puckering, till the foremost ends of the harpins exactly agree with their spots or stations on the stem; and, in like manner, till the spots made for the stations of the cant-timbers and harpins agree; fixing them with needles till the whole fore-body every where reconciles. Then mark on the draught (Plate 3.) the intersections of all the girts. Those from the timbers, when curves are drawn to the spots, will represent their moulding edges; as those from the harpins, when the lines are drawn, will likewise shew the upper edges of the harpins. Lines being now drawn, parallel thereto, or nearly so, to the depth or scantling of the harpins, will shew the lower edge of the harpins and ribbands: likewise, by setting off the scantlings of the timbers on each side of the joint, curves being drawn thereto, will represent the fore and after sides of all the timbers.

TO EXPAND THE AFTER CANT-BODY AND TRANSOMS.

The expanding of the after cant-body, as far aft as the fashion-pieces, is so similar to that of the fore cant-body, just described, as to require but little additional explanation.

When the after cant-body is expanded, the openings between the timbers may be shewn, by a faint shading; likewise the openings between the hawse-pieces and transoms when drawn, which now only remain to be described.

In laying-off, as shewn in Plate 35, where the moulding edges of the transoms intersect the foremost cant fashion-piece in the body-plan (Fig. 1.), take their distances, in the direction of the fashion-piece, from any given spot (as in the third futtock ribband, there represented by a small circle, the centre of it is the spot intended); then set off those distances in the direction of the aftside of the foremost fashion-piece (Plate 3.) above and below the third futtock ribband, there shewn. Then, where the buttock lines, 1, 2, 3, 4, and 5, in the body-plan (Fig. 1, Plate 35.) intersect the foremost square fashion-piece, level them out to cross the foremost cant fashion-piece, there represented by dots, and take their distances from the third futtock ribband, in the direction of the fashion-piece, setting off those distances from the third futtock ribband, in the direction of the aft side of the foremost fashion piece, (Plate 3.) which will give the stations of the buttock lines on the aft side of the fashion piece.

Where the ribbands 1st, 2nd, and 3d, intersect the upper and lower edges of the transoms in the sheer-plan (Fig. 2, Plate 35.) square them down to their corresponding edges in the plan of the transoms, (Fig. 3, of the same Plate.) The upper edges of the ribbands are in the plate represented by dots, that they should not confuse the rest of the work.

Now girt slips of paper round the buttock lines, 1, 2, 3, 4, and 5, in the sheer plan, (Fig. 2, Plate 35.) and mark on them the sides of the fashion pieces, the upper and lower edges of all the transoms, (noting the difference to prevent confusion), likewise the margin line where the buttock lines terminate.

Then, with other slips of paper, girt round the moulding edges of all the transoms; also their under sides below the wing transom, in the plan of the transoms, (Fig. 3, Plate 35.) marking thereon the several buttock lines, the spots representing the ribband lines, the foremost and other fashion pieces, and inside of the rabbet of the stern post (which will shew the greatest lengths of the planks when expanded, or, as on the ship when wrought.) Then stretch the several girts of the transoms and buttock lines, as on Plate 3, fixing the spots for the foremost fashion piece to its corresponding spots at the aft side of the foremost fashion piece. Then move the girts till their corresponding spots agree with those for the buttock lines, and likewise with those for the edges of the transoms; and, confining them with needles, mark the intersection of each girt and the spots for the ribbands. Now, by describing curves through the respective spots, the edges of the transoms will be shewn, likewise the buttock lines where they intersect the transoms, as also the ribband lines to which the girts of the ribbands may be applied: and, if rightly executed, the extreme lengths will agree.

The utmost length of the planks round the buttock is now determined, by the margin line on the upper side; and, on the aft side, by the rabbet of the post on the girt of the transoms. It only now remains to complete the rabbet of the post to the keel.

Stretch a slip of paper up the rabbet of the stern post in the sheer-plan, (Fig. 2, Plate 35.) then mark on it the upper and under sides of all the transoms, the floor ribband, and those above it, with the lower edge of the rabbet of the keel. Then fix it on the plan of expansion, (Plate 3.) keeping the spot for the lower edge of the rabbet, well with the rabbet of the post on the straight line; next removing the slip of paper till the spot for the floor ribband agrees with its floor ribband already there, fix a needle, and move the upper part of the slip, without puckering, till the spots for the transoms agree with their corresponding spots: a line being then described, to the edge of the slip, will represent the extent of the planks below the transoms.

The girts of the curves of the harpins and ribbands above the main wale being expanded, in a similar manner, will give the boundary of the topside to the rabbet of the stem forward, and to the aft side of the stern timber abaft; as, likewise, the upper and lower edges of the wales, ports, &c.

The whole side being now expanded, from the keel to the topside, the planks may all be shifted agreeably to the foregoing observations; beginning with the main wale, or the strakes between the wales and the ports, as they must give the strongest shift possible to the ports and to each other. The sheer strakes, as before observed, should be scarphed with a hook in the middle, and be so disposed as to give the greatest strength to the drifts and each other: the strakes between the wales and sheer strakes may be next divided, as to their number and breadth; and, if the lower strakes, or those nearest the main wale, are the broadest, and gradually diminish in breadth upwards, they will be more easily obtained; as they are thicker, and make the topside look better.

The plan which we have described is the only method of ascertaining what planks are the most proper to work up or down to the ports, and which to cut upon: for, till this is determined, there can be no certainty in shifting the butts; because, if those planks which must be cut by the ports, should be found to be cut too much, or that it should appear better to work to the ports with the strakes next them, then, to avoid bad work, or introduce very long planks, some of the butts will want shifting. Here may be seen the great utility of expanding the top-side; for, if these things are not considered before the work be too far advanced, an indifferent shift will probably ensue.

When there are three strakes between any butt, over or under a port, the butt had better be brought to fasten upon the frame that makes the port.

The longer the planks are shifted, the stronger will be the topside; but the general length of planks must ever be considered; because, when the ship wants repairing, planks must be cut on purpose, and green planks will be worked where seasoned planks only ought to be used. We have been the more particular in explaining the shift of the topside, because the strength of the sheer, in every ship, depends, principally, upon the shift of the planks above her seat in the water; and, as the butts of the clamps and spirkettings should be shifted as clear of the butts on the outside as is possible.

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§ 7. INSTRUCTIONS FOR DELINEATING THE INBOARD WORKS OF THE EIGHTY-GUN SHIP; WITH OBSERVATIONS ON THE INBOARD WORKS OF SHIPS IN GENERAL.

Draughts of the outboard works being now constructed, and every part described requisite to the putting the ship in her frames and planking, we now proceed to form a draught of the cavity of the ship, or Inboard Works, in such a manner as to exhibit the arrangement and disposition of every thing therein contained, to the best advantage.

Sometimes the inboard works are drawn in the sheer draught; but, when so drawn, they generally appear much confused; it is therefore the best and easiest method to appropriate a draught to that purpose, by which every particular will be more clear and conspicuous. And when this be drawn, the artist will not be under the necessity of working from his principal draught.

The Draught of the Inboard Works, Plate 4 of this work, will give the reader a correct idea of all the particulars which it is designed to exhibit. To this plate he will find it necessary to refer throughout the following instructions.

For the construction of the draught, take, in the first place, from the sheer-draught, the scale, stem, stern post, counter timbers, keel, cutting-down line, keelson, apron, transoms, fashion-pieces, decks, and centres of the masts; also the drifts, plank-sheer all fore and aft, the joints of the frame-timbers, and the ports, which will be found to be all that is necessary for our present purpose.

The beams come now under consideration, and should be so disposed as to come one under, and one between, each port, or as near as can be to answer the other works of the ship, as the hatchways, ladderways, &c.; but, where it happens that a beam cannot possibly be placed under the port, then a beam arm should be introduced to make good the deficiency.

To draw the beams in the draught; take the moulding of the lower deck beams from the dimensions, and set it off below the line representing the deck at the side; then draw a fine line in pencil parallel thereto, which will represent the under side of the beams: in the same manner draw the under side of the beams for the upper deck, quarter deck, forecastle, and roundhouse; then take the siding of the lower deck beams, and place one under, and one between, each port, all fore and aft, only drawing them in pencil. Now draw in the centre of the main-mast, and set off the size of the mast and main step. Then draw in the chain-pump that comes before the main-mast, and design the lower futtock-rider clear of its heel. The third futtock-rider which comes upon the head of the lower futtock-rider and faces quarter inch and a half on the aft side of the orlop beam, gives the station of the orlop beam, before the main-mast. Flush on the aft side of the orlop beam comes the fore part of the well. Now take, from the table of dimensions, what the well is fore and aft, which is about ten feet; set it off abaft the beam before the main-mast, and that distance will be the station of the two beams, one afore and one abaft the main-mast, which may then be drawn in ink, and will terminate the extent of the well the fore and aft way. As there cannot be a beam across the ship in this part by its being the well and mast room, there must be a beam-arm between those two beams, placing the end at the side its thickness nearest to that beam it does not bolt to, as on the upper deck. On the gun-deck we have reversed it, as by that means the hanging knees bolt to different timbers.

The main hatchway, fore and aft, as in the table of dimensions, is 8 feet 6 inches, which set off before the beam that forms the fore part of the well; the aft side of this beam then forms the fore side of the hatchway; this beam may now be drawn in ink. Another beam-arm must be introduced in wake of the main hatchway.

The fore hatchway may now be determined, the fore side of which should range well up and down with the after end of the forecastle, and fore and aft as in the Table of Dimensions. At the fore side of the fore hatchway there must be a ladder way down to the orlop, which may be fore and aft agreeably to what the space of the beams will allow; the rest of the beams afore the fore hatchway may remain as first placed, if the riding bitts will admit of it: then determine on the after hatchway, the fore side of which comes to the aft side of the main mast room.

There thould also be a hatchway over the fish room, which is for the convenience of the spirit and fish rooms; and there should be a ladder way abaft it, which should lead down to the cockpit. The size of the ladder and hatchways must be governed by the beams, as when there is once a good shift of beams they should never be altered for ladder and hatchways, unless for the three principal hatchways, which must always be of a proper size, according to the size of the ship, as given in the Table of Dimensions.

The after or main jear capstan must be placed between the two hatchways last described, and the beams abaft may stand as they are already placed, recollecting only the situation of the mizen mast. There should be a scuttle placed afore the second beam from aft, as in the table of dimensions, for the convenience of the bread room; it must be on the starboard side of the middle line; and, one scuttle must be formed on the larboard side, close aft, to go into Lady's Hole, as there is a carling at the middle under the four or five after beams, to receive the pillars for the support thereof.

The riding bitts may now be placed, letting the fore side of the after ones come against the aft side of the beam abaft the fourth port, and the foreside of the foremost ones against the next beam, but one forward; then, at the fore side of the larboard bitt pin, there should be drawn a scuttle, as in the dimensions, for the convenience of handing up the powder from the magazine. The deck breast-hook should also be drawn, which may be as broad as can be gotten the moulding way, and sided agreeably to the dimensions.

The gun deck-beams, knees, &c. being described, we shall now proceed to the upper deck; the precautions already mentioned in spacing the beams must be taken, upon all the decks that have ports; only observing to keep the beams upon one deck as near as can be over the beams on the other, for the convenience of pillaring, as they will then support each other.

The hatchways are now to be considered, placing them all exactly over those on the lower deck, so that, consequently, where there is a beam arm on the lower deck, there must likewise be one above it on the upper deck, and the same on the middle deck in three decked ships. It commonly happens, in ships of the line, that there cannot be a whole beam between the deck breast-hook and the beam that supports the step of the bowsprit, because the bowsprit passes down through that place; when it so happens, a beam arm must be placed as in the draught, letting the end come equally between the beam and the breast hook; but, in ships whose bowsprit will allow of a whole beam, the ports and the rest of the beams must be consulted, in order to space it; and, when it so happens that the foremast comes in wake of a port, a beam arm must, necessarily, be introduced.

Having spaced the beams of the upper deck according to the disposition of the beams below, the ladder ways should be so contrived, that there should be one next abaft the fore hatchway, which is a single ladder way, and one next afore the main hatch, which is a double ladder way, the ladders standing the fore and aft way; and, likewise, one over the cockpit, corresponding with that on the lower deck.

The next object to be considered are the capstans*; the after one is already placed on the lower deck, and its barrel passes through the upper deck to receive the whelps and drumhead there, it being a double capstan. In three decked ships the upper part of the capstans is on the middle deck. Frigates, or small ships, have only one capstan, the upper part of which is placed on the quarter deck. The fore jear capstan should be fixed in the most convenient place

* A full explanation of the methods of constructing the capstans is given hereafter, elucidated by a large engraving. See Plate 7.

to admit of its being lowered down to the orlop, out of the way of the long boat; therefore it may be placed next abaft the ladderway at the fore hatchway. The beams on each side of it should be placed exactly over or under the beams on the other decks, and should be at a sufficient distance from each other to permit the drumhead to pass between them. The centre of the capstan should then be placed in the middle between the beams which compose its room, and the partners should be fitted in such a manner as to shift occasionally when wanted. The partners on the lower deck, wherein the capstan steps, must be supported by a pillar on the orlop deck, the lower part of which may be fitted in an oak chock, that fits in the step; so that, when the pillar and chock are taken away, and the capstan is lowered down, that chock serves as a step for the capstan; the two beams on the orlop, having the pillar and chock upon them, have, consequently, the whole weight of the capstan pressing downwards; and, for the better support of them, a carling should be placed beneath, the fore and aft way, with three pillars, one under each beam, and one between. All these pillars should be stept in the keelson, by which the orlop deck will be well supported in wake of the capstan, and the other decks have no strain arising from it.

Now dispose of the fire hearth, which is placed differently according to the size of the ship; for, in three deckers, it is found most convenient to place it on the middle deck, which of course gives much more room under the forecastle than it would have were the fire hearth there. In all two decked ships it is placed under the forecastle, because on the main deck beneath the riding bitts are in the way. In frigates and small ships it is fixed under the forecastle, though confined between the riding bitts; therefore, in such ships, it should be kept as near as possible to the after riding bitts, that there may be the more room between it and the foremost riding bitts, to form as convenient a galley as circumstances will admit.

The main-top-sail-sheet bitts next claim our attention, the foremost of which must be placed so as to have its aft side against the fore side of the beam abaft the main hatchway, and so as to pass down to the lower deck, and there step in the beam below. The main jear bitts must be placed against the fore side of the beam abaft the mast, and step on the beam below. The cross pieces to the bitts should be on the fore side of the foremost bitts, and abaft the after ones, and should be in height, from the upper deck, about one third of the height between it and the quarter deck, or, as given in the dimensions. With regard to the heads of the bitts, we should consider the length of the ship's waist; and, if there is length enough from the forecastle to the foremost bitts to admit of the spare geer being stowed thereon, without reaching farther aft, the quarter deck may run so far forward that the head of the foremost bitts shall tenon in the foremost beam, which gives the main mast another deck, and admits of the quarter deck being so much the longer; but, if there is not the extent above mentioned, the quarter deck must extend no further forward than the after bitts, which will tenon in the foremost beam; the foremost bitts must have a cross piece let on their heads, which is termed a horse, and used to receive the ends of the spare geer.

We may now proceed to the quarter deck and forecastle. The length of the quarter deck being before determined upon, the first object presenting itself is the beams; therefore, in placing them, the different ladderways, gratings, &c. on the quarter deck should be consulted;

observe that, it is unnecessary to have in the quarter deck, round-house, and forecastle, carlings or ledges (except carlings for the hatches). But, having no carlings or ledges, the deck necessarily requires a greater number of beams, and a good round up: otherwise it would be apt to bend with its own weight. The most approved rule, therefore, is, to have double the number of beams in the quarter deck, as in the upper deck in the same length. If heavy metal is intended to be used on the quarter deck, then it will, however, be necessary to frame it with carlings and ledges.

Proceed now to shift the beams to the greatest advantage, consulting the hatchways, ladder-ways, masts, bitts, steering wheel, &c. In respect to the ladderways on the quarter deck of all ships, there should be one near the fore part of the great cabin for the officers, and one on each side at the fore part of the quarter deck from the gang ways. In every ship of the line all the beams from the ladder way to the four beams before it, should be open, with gratings, for the more expeditious conveyance of different things in time of action, as well as for air.

Two scuttles may be disposed, one on each side in the room abaft the main mast, (if the main mast happens to come through the quarter deck) for the top tackles to pass through, to hookto the eye bolts driven in the upper deck for that purpose. Scuttles are also to be formed on each side the mainmast for lifting the pumps, &c.

Now dispose of the steering wheel, which should be placed under the fore part of the round-house. The two beams of the quarter deck which come under it should be placed conformably to the two stantions of the wheel, so that they may tenon in them. It should be observed, that the beam abaft, which comes under the screen bulkhead, should round aft agreeably to the round of the bulkhead, for the support of the same. This bulkhead is sometimes placed abaft the gallery door.

The forecastle beams should be placed as the works of the deck, as the scuttles, &c. will admit. There should be a scuttle for the funnel of the fire hearth to pass through, another over the copper to give vent to the steam, and one or two over the galley, as the forecastle may admit. The fore-top-sail-sheet bitts should be so disposed as for one pair to come on the fore, and the other on the aft, side of the mast, to let into the side of the forecastle beams, and step on the upper deck beams below. The after bitts are to cast at the heels so as to lead the tack clear of the galley. There must also be a ladderway at the fore part of the forecastle for the convenience of the fore part of the ship.

After these things have been considered, the beams may be placed agreeably to them, letting the number of beams be four more than there is in the upper deck, in the length of the forecastle; and, where there happens to be a wide opening between the beams, as at the mast room, &c. where a half beam is to be introduced, that will make good the deficiency. The foremost or cat-beam should be broad enough to take the aft side of the inboard arms of the cat-heads, as they are secured upon this beam by being bolted thereto; and, to take a five inch rabbet to receive the ends of the forecastle flat.

Now proceed to the Round-House, letting the same observations suffice with respect to the beams as were made on those of the quarter deck; for, as the round-house beams are sided less, they ought, consequently, to be nearer to each other; therefore, let the number of beams on the round-house be in number four more than in the same length of the quarter deck. The round-house should always have a great round-up, both for strength and convenience. Upon it there must be a small pair of knee bitts on each side of the mizen mast, bolted through the mast carlings. It must also have a companion placed over the middle of the lobby, in order to give light thereto.

With regard to placing the round-house beams, we have only to attend to the foremost stantion of the steering wheel, and the mizen mast; as, when the beams which interfere with those parts are properly spaced, the rest may be disposed of at discretion, or at equal distance from each other, letting the beam over the screen bulk-head have a proper round aft, agreeably to the quarter deck beam underneath.

The upper parts of the inboard works being now described, we may proceed to the lower parts, or those which come beneath the lower deck; therefore draw in the orlop by taking the heights afore, amidships, and abaft, between that and the gun deck, from the dimensions, and drawing a curve to pass fore and aft, the upper part of the deck will be represented; then, setting off the thickness of the plank below the upper side of the beams, the under side of the plank will be represented also. But, as this deck does not run quite forward or aft as the other decks, we must next determine on the length of it; therefore, let the after beam be placed at a sufficient distance from aft, to admit of the bread room's being of a proper size for the ship, which will be under that beam of the gun deck that comes at the second port from aft.

The after beam being drawn in, proceed to space the other beams, placing them exactly under those of the gun deck, and that which comes under the second beam from forward of the gun deck may terminate the fore part of the orlop. Draw the limber strake, by setting off its thickness above the cutting down line, and drawing a curve parallel thereto, it will be represented. That part of the orlop which is over the after magazine, spirit room, and fish room, and that likewise which is over the fore magazine is laid with thicker plank than the rest of the deck, and rabbetted, for the better security of those places. The plank is likewise laid over the beams, and a wet lining of slit deal over that; but, amidships, from the fore part of the spirit room, to the aft part of the foremost magazine, the beams are laid flush with the surface of the deck, sometimes one inch above, and the flat is rabbetted in from one beam to another.

Therefore, to represent the orlop as just described, we must determine on the different apartments above mentioned; letting the aft side of the after beam be the aft side of the after magazine; thence draw the bulk-head down to the limber strake; and the fore side of the after magazine, as in the Dimensions, drawing that bulk-head likewise, which will also form the aft side of the fish room; then the fore side of the fish room, as in the Dimensions, may be drawn, which will also represent the aft side of the spirit room; then the fore side of the spirit room may be drawn in like manner. From the fore side of the fifth beam quite aft, the deck will now be represented by the two lines already drawn, and the upper side of the beams by the lower line.

Now proceed to the fore part of the orlop, letting the fore side of the after bitts be the aft part of the foremost magazine, drawing the bulk-head thereof; thence to the foremost end of the orlop, the plank and beams will be represented in the manner described for the after part of the orlop; the midship part of the deck will be represented by letting the upper line be the upper side of the plank, and likewise the upper side of the beams, unless when the beams are left up above the flat; and, the lower line will represent the lower edge of the flat, only drawing it from beam to beam, and without passing through them.

The hatchways, &c. may now be represented on the orlop, with the main, fore, and after, hatchways, exactly under those of the gun deck; there must be one over the fish room, and one over the spirit room; there must also be two scuttles on the starboard side, over the after magazine, for the passages to the magazine and light room; there must also be one afore the fourth beam from forward, on the starboard side, for the passage to the fore magazine, and one abaft the second beam, on the larboard side, for the passage to the light room.

The bulk-heads for the fore and after parts of the well may now be drawn from the lower deck beams to the orlop, and loovered; thence to the limber strake in the hold they are solid. The shot lockers may also be represented, one afore, and one abaft the well; there should also be one abaft the foremost magazine, under the platform of the gunner's, the boatswain's, and the carpenter's store-rooms. The steps for the masts may be drawn in by continuing their centres down to the limber strake; and, also, two crutches abaft the mizen step, divided equally between that and the after part of the cutting down; the breast-hooks, five in number, may also be drawn below the lower deck hook, and all equally divided between that and the fore step.

Thus will every part of the Inboard Works be described in profile, together with the outboard works, and the body and half-breadth plans. It therefore remains for us only to add an explanation of the methods made use of in constructing plans of the decks, &c. in order to exhibit the various apartments and accommodations to be erected in the internal completion of the ship, which is, consequently, given in the following section.

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§ 8. INSTRUCTIONS FOR DELINEATING PLANS OF THE DECKS, &C.

First take, from the sheer plan, the heights, at every timber, of each deck at the side, and set them up square, or transfer them, from the base line in the body plan to intersect their corresponding timbers represented by the ticked curves in the body plan, Plate 1.

Then, upon the paper for each plan, draw a middle line; and, from the sheer plan, square up the stations of all the square timbers. Next take, from the body plan on Plate 1, the half breadth of each timber at the height of the deck intended to be drawn; set this off, on each side of the middle line, at its respective timber and plan; then square down, from the sheer plan, where the deck intersects the aft side of the stem and fore side of the stern-post, at the rabbet, upon the deck plan; and, on those lines, set off half of the thickness of the stem and stern-post. A curve drawn through those spots will give the boundary of the deck to the outside of the timbers. Within this line set off the moulding or substance of the timbers, and it will give the line by which the length of the beams will be determined.

Upon each plan square down, from the sheer plan, the fore and aft sides of all the ports; and, from the profile, (Plate 4.) the fore side and aft side of all the beams: then square them athwart from the middle line.

As the fittings up on each deck are very different, it becomes necessary to describe each deck separately. But, as the sides of all are nearly alike, it has been deemed sufficient, in our draughts, (Plates 5 and 6.) to give one side only. Wherever there is a difference, it will be found described in these instructions.

To the middle line of the plan of the Gun, or Lower Deck, (Plate 5.) square down, from the profile, the centres of the masts, the capstans, pumps, riding and other bitts, hatchways, ladderways, scuttles, and riders.

Draw in the mast partners, placing them on each side of the middle line, agreeably to the dimensions; and, at the mizen mast, the step only. Draw in the riding bitts, on each side of the middle line, with their cross-pieces, according to the dimensions; likewise the standards, the foremost of which form the partners of the foremast. Between the standards are two cap scuttles, for the convenience of handing any thing up from the gunner's store room, &c. Before the foremast is the manger, which should be as large as possible, reserving room for the foremost gun, and of sufficient height under the bowsprit. Now draw in the bowsprit step close before the foremast partners. Then draw in the framing of the fore hatchway, and the ladderway before it, agreeably to the dimensions. The partners of the fore jear capstan may next be drawn, placing the coamings equally from the middle line, and sufficiently clear for lowering the capstan freely between them.

The main hatchway may next be framed, agreeably to the dimensions.

The main jeer and top-sail-sheet bitts are to be represented so that their insides may plumb with the centre of the pumps. The inner cases of the pumps must not wound the main partners more than can be avoided. The rhodings and winches of the pumps and pump pillars may next be drawn. The step and pall rim of the main jear capstan and the framing of the after hatchway, the hatchway over the fish room, and ladderway to the cockpit, may now be drawn agreeably to the dimensions; likewise a cap scuttle on the starboard side, over the powder-room passage, for the conveyance of cartridges, and another over the bread room, on the larboard side; also, one close aft, on the starboard side, over Lady's hole. In the midships are to be drawn the standards against the transoms.

On our plan of this deck we have endeavoured to shew the nature of framing the deck, and have likewise represented the knees and riders, shewing the iron lodging knees behind them, which are fayed to the timbers, and having before them a filling, making flush with the clamp.

The Carlings are also shewn in tiers, as directed in the table of dimensions; as, likewise, the ledges. The binding strakes, with their butts, are shifted so as to give the most strength in the hatchways; and, upon the inner strake, all the stopper bolts are represented.

The Orlop Plan, and works in the hold, next claim our attention; therefore, to the middle line of the orlop plan, square down from the profile the centres of the masts, the heels of the riding bitts, the hatchways, and scuttles.

Then sweep in the size of the foremast and mainmast, at the middle line, and draw in the hatchways of the same size as on the lower deck. The scuttles may likewise be represented.

The after scuttles are two in number, abreast of each other, one to the light room, the other to the powder room. The next scuttle forward is in the middle line, and over the fish room; and the next before is a large scuttle, in two flaps, over the spirit room, with a shifting carling in the middle. The next scuttle is before the fore hatchway, in the middle line, and leads to the gunner's stores. There is one on each side before it; that on the larboard side leads to the boatswain's stores, and that on the starboard side to the carpenter's stores. The next before these, on the starboard side, is the scuttle to the magazine; and, abreast of it, is a small cap scuttle, for the conveyance of cartridges. Forward, on the larboard side, is a scuttle to the light room. In the wings, also, are scuttles of admission below in the time of action.

The wings are represented and parted from the side by bulkheads, leaving sufficient room from the side to swing a mall so as to stop a shot hole. Sometimes stantions, instead of a bulkhead, are put up near each other, and are preferred, particularly in the store rooms.

Next to the wing forward, on the larboard side, is drawn the boatswain's store room; and, before that, a sail room. Between the after riding bitts are two doors; the larboard door belongs to a passage leading to the light-room, and the starboard one to the passage leading to the gunner's store-room amidships; and, likewise, to the magazine passage. On the larboard side, abaft the store room, is a cabin for the boatswain; and, opposite, on the starboard side, is a cabin for the carpenter. Next before the latter is a store-room for the carpenter.

Close abaft the fore hatchway a sail room is to be drawn amidships; and, abaft it, the capstan room. Between the capstan room and the main hatchway is another sail room. Abaft the main hatchway is drawn the continuation of the pump well upwards, to the size given in the dimensions.

Into the side, from the fore to the after platform, the wing is to be drawn, as parted off with stantions; between the stantions are latticed panels, that the side may be kept clear. At the fore side of the main hatchway, and aft side of the fore hatchway, are to be inserted stantions for crowning the cables.

On the after platform, the wing is to be continued to the bulkhead of the steward's room; and, within the wing on the larboard side, at the fore part is to be drawn the marines' clothing room. Next abaft it, a slop room, then a cabin for the purser; and, next abaft, a room for his steward. Directly opposite, on the starboard side, is the surgeon's cabin; and, next before it, the captain's store-room, with double doors. Before the captain's store-room is that for the first lieutenant.

A bulkhead is to be represented, inclosing the scuttles to the light room and powder room; and, between the powder room door and surgeon's cabin is a dispensary. Abaft the thwartship bulkhead is a bed place for the purser's steward, and racks for stowing cheeses separately. Abaft the whole is the bread-room; and, just before the transoms, a bulkhead abaft which forms Lady's hole.

Upon this plan it is customary to shew the conveniencies under or in the hold, such as the light room forward, parted from the grand magazine by a thick bulkhead, in which are the jambs for fixing the lights and spla-boards for throwing the light more into the magazine. Next abaft is to be drawn the magazine inclosed by a strong bulkhead; but that part next the wings, or ship's side, is made to take down occasionally, in panels. In the fore part of the magazine amidships, is the filling room; and, abreast of it, are racks for filled cartridges. The palleting, or flat of the magazine, is fitted with square scuttles, as drawn, to prevent damps. It is parted from the filling room by stantions and a battened bulkhead. Next abaft the magazine is drawn a platform, having a store-room for the boatswain, on the larboard side, a store-room for the gunner, in midships, and one for the carpenter, on the starboard side. Under the platform is a shot-locker, with a parting bulkhead amidships, and there is a scuttle to each from the gunner's store-room.

Around the main mast are drawn the well and shot-lockers, agreeably to the dimensions. Under the after platform are drawn the bulkheads which form the spirit-room and fish-room; abaft which is the powder-room, with its light room and passages. The powder-room is drawn with its racks for stowing the filled cartridges, the whole of it being occupied for that purpose.

The plan of the UPPER DECK comes next under consideration, therefore, for this, square down to the middle line, in the first instance, from the profile, the centres of the masts, the capstans, the jear and top-sail-sheet bitts, hatchways, ladderways, and riders; the fore part of the beak-head, and the bulk-head of the wardroom.

On the plan of this deck draw in the plan of the beak-head, thus: first, draw in the collar beams or carlings, at the height of the beak-head, to its siding abaft the fore part of the beak-head, upon which draw in the stantions; observing to keep the two outer stantions to the size of the round-houses, and so that they may be kept far enough out for the funnel to come clear of the side. The third stantion from the middle line must be spaced so as to make the bow-chase port. The next stantion within makes the head door; and, the stantion next the middle line is made by the large stantion into which the collar carling is tenoned. On the midship side of the head door is a scuttle over which a flap is hung. The fore tack leads on board through this scuttle to the capstan, occasionally.

The heels of the fore-jear bitts may now be drawn; but observe, that the heels either of the fore or after ones must cast sufficiently from the middle line to lead the fore tack clear of the galley, which has a sheeve or roller fitted into it for that purpose.

The partners of the foremast may next be drawn in the same manner as the main part runs on the gun-deck. Thence aft are to be delineated the cants for the galley, which is inclosed abaft by two doors.

The fore hatch and ladderway, as likewise the partners of the fore jear capstan, may be represented as on the lower deck; also the ladderway and main hatch, the main mast partners, and after hatchway. The partners for the main jear capstan are represented as those of the fore jear capstan; and, the framing of the ladderway with gratings abaft, as directed in the table of dimensions, likewise the partners of the mizen mast. Draw, athwartships, the bulk-head of the ward-room; and, abaft, the rudder head and casing round it, as shewn in the plate. Upon this plan is to be represented in ticked lines, the tiller and plan of the tiller sweep beneath the upper deck. A ticked line is likewise to be drawn representing the tiller rope leading fair to the blocks fitted under the beams in midships; also, another ticked line, directing it upwards to the wheel upon the quarter deck, to shew that the blocks and wheel are properly placed to keep the rope clear of the upper deck beams.

Upon the plan of this deck the flat is shifted, having strict regard to the lengths. The flat of the deck, close to the side, is oak, which is shifted in suitable lengths from twenty to four and twenty feet, and anchor stocked, or else top and butt, to assist the conversion of the top end. Between the riders the waterways and first strake are consequently cut off, and abaft the riders are two iron standards.

From the deck transom to the aft part of the forecastle, excepting next the side, this deck is laid with deal; and much waste would be made if the butts were not correctly shifted to their lengths, which will be from thirty-six feet to forty feet. Under the forecastle the flat is oak, consequently of short lengths. Abreast of the galley it is customary to leave a part of two strakes one inch above the deck, in order to prevent the cook from damaging any part of the deck near the galley.

The butts of the binding strakes are to be so disposed as to give as much shift as possible to the hatchways. The binding strakes may be of East-country plank, as English plank can hardly be procured of the lengths required.

The knee under the cat beam prevents the hanging of a door at the aft side of the round-houses; they are, therefore, represented as inclosed, and so as not to interfere with the foremost gun. The plan of the forecastle is now to be considered. Upon this plan is shewn the construction of the fife rail that lets over the heads of the beakhead stantions, with the chase-ports and upper part of the round-houses. Abaft the latter is to be delineated the plan of the cathead and cat's tail; also the knee abaft the cathead. Amidships is framed a ladderway, and round the foremast is drawn the fore-top-sail sheet and jear bitts, with the cross-pieces. Abaft the fore mast, on each side, is shewn a scuttle for the top tackles to lead through to an eye-bolt on the upper deck. Over the galley amidships are framed the steam gratings; and, between them, coamings for the chimney funnel. At the aft part of the forecastle is drawn the bellfry bitts, with knees to support them; and, over the breast beam are drawn the foot rail and stantions.

Along the waist, at the side, is shewn the plan of the gang boards and fixed gangway.

Upon the plan of the quarter deck, over the breast beam, is to be drawn the plan of the breast rail and foot rail, with their stantions.

On each side of the main mast, is framed a flat scuttle through which the pumps, &c. may be lifted; and, abaft the mast, is drawn the brace-bitts. Abaft the brace bitts, on each side, is a scuttle made use of for leading the main top tackles to an eye-bolt in the upper deck.

The framing of the gratings and ladderway may next be drawn, as directed in the table of dimensions; and, abaft these, the steering-wheel, with its stantions; then the mizen mast; and, abaft that, the bulk-head of the lobby and bed place. Abaft the latter is to be inserted the screen bulk-head.

There will be no occasion for a drawing or plan of the round-house; as, besides its beams and ports, there are only the mizen-top-sail sheet bitts, a companion over the bed place, and the taffarel knees abaft.

CHAPTER IV.

EXPLANATION OF THE METHODS OF LAYING OFF ALL THE PARTS OF A SHIP ON THE MOULD-LOFT FLOOR, PREPARATORY TO THE ACTUAL CONSTRUCTION OR BUILDING.

Having now conducted the student through the most difficult parts of the theory, and enabled him to make those determinations which must be established previous to the construction of a draught; having furnished him, also, with all requisite instruction for the delineation of the several draughts and plans; we now proceed to describe the methods made use of for the delineation of the shape of the different parts of the ship, in their proper size, on the Mould-loft Floor, with other matters necessary to be known, in order to the actual raising or building of the ship.

In perusing these Instructions, the Reader will find it requisite continually to refer to the seven plates of Laying-off, *numbered from 32 to 38, and upon which the name, or description, of every particular will be found.*

§ 1. OF LAYING DOWN THE SHEER, HALF-BREADTH, AND BODY, PLANS.

From a draught designed upon paper, for the purpose of laying it down, and expanding it to its full size, on the Mould-loft Floor, we must, in the first instance, take off all the dimensions for laying off the body: and, in the manner that we have shewn, with respect to the dimensions of bodies in the construction of the draught, take off what scantlings may be wanted, which will be found in the table of dimensions. These are to be entered in a small book; for, were the draught used upon the floor, it would disfigure it very much.

The ship which we now propose to lay off, is, as before, the eighty-gun ship of two decks.

It may, perhaps, be necessary here to premise a few observations relative to the transferring of lines from one plan to another. The three principal plans are denominated *sheer-plan*, *half-breadth plan*, and *body-plan*. In order to facilitate the laying off, and to prove the fairness or correctness of the various curves, certain operations are performed in which the lines peculiar to one plan are transferred to, or shewn upon, another plan. Thus the lines on the body-plan are transferred occasionally, some to the sheer-plan, and some to the half-breadth plan; those of the sheer and half-breadth plan are, in like manner, sometimes transferred to the body-plan: but there is very seldom any occasion to transfer the lines of the sheer-plan to the half-breadth plan, nor those of the latter to the former. The sheer-plan is intended to exhibit heights and lengths on a perpendicular plane or longitudinal section. The half-breadth plan exhibits half the breadth of those heights and lengths on a horizontal plane; and the body-plan is compounded of heights, breadths, and lengths, on a perpendicular or transverse plane. The lines of the sheer-plan are transferred to the body-plan by means of their heights taken at various parts on the sheer-plan, and those same heights measured off as heights upon the body-plan from the base line. If those heights are set off successively along the base line in the body-plan, they form curves, as the main-breadth and top-timber line or diagonals as the ribband lines; if they are set off above the base line, in succession, on the same vertical, they ascertain the places of other lines on that vertical, as the buttock lines ascertain the places of the timbers. All horizontal lines on the sheer-plan will be horizontal on the body-plan, as the water lines when parallel to the keel.

The lines of the half-breadth plan are transferred to the body-plan by means of their distances taken at various parts from the middle line on the half-breadth plan, and those same distances measured off from the middle line of the body-plan, either in a horizontal or diagonal direction. If measured off successively along the middle line, they form curves as the boundary of the floor sweeps. If measured diagonally, they ascertain the places of other lines on that diagonal, as the timbers are by the diagonals. All lines parallel with the middle line on the half-breadth plan are equally parallel with and equidistant from the middle line of the body-plan as the buttock lines.

Mould-lofts are seldom long enough to admit the laying off of any large vessel in one length; in small mould-lofts they must, of course, lay off in three or four lengths. To lay off in one length would, also, cause unnecessary waste of time, for many of the perpendiculars of the fore-body answer alike for the after-body also.

The Mould-loft Floor being cleared, we begin by striking a straight line from one end to the other, as A B, *(plate 1. of laying off,)* in distance from the side of the loft about as much as the keel is deep.

The line A B will represent the upper edge of the rabbet of the keel, in the sheer and body plans, above which all heights are to be set up; and, it will represent, also, the middle line of the half-breadth plan.

Now, upon the line A B, set off and erect towards the right hand, the foremost perpendicular; observing to keep in distance from the end sufficient space for the length of the head: and, particularly if the length of the loft will admit of it, from the foremost perpendicular set off the station of dead-flat, and two or three timbers abaft it, as (3) (5); then strike in the intermediate perpendiculars representing the joints of the frame timbers B D F H K M O Q S U X, taking their *Room* and *Space* from the draught or table of bodies.

Having erected the perpendiculars, or joints of the frame timbers, describe, in the sheer-plan, the stem, thus; set up its height from the line A B, and distance at the head from the foremost perpendicular from the table of dimensions, so, likewise, the centre from which the lower part of the stem is swept; then set off the moulding of the stem, by which the aftside is obtained; and, before that sweep a parallel curve, as far distant from the aftside of the rabbet as the bottom plank is thick; but, if the rabbet is to be in the middle of the stem, it must be laid off agreeably to the draught. In the 80 gun ship the rabbet is on the aftside.

Take the heights of the lower and upper heights of breadth from the table of bodies, and set them up on their corresponding timbers in the sheer-plan from the upper edge of the rabbet or line A B; then, by pinning a batten to those spots, or heights, produce the fair curves of each.

Strike in the out lines of the body plan, that is to say, the middle-line, the side-line, and the base-line. The base-line may be represented by part of the line A B in the sheer-plan (on the floor) and the middle line by one of the midship timbers; or, in small mould lofts, where the breadth of the loft is not sufficient for the height of the body, the bodies must be laid down lengthways in the loft; the line A B on the sheer-plan will then represent the middle line of the body, and one of the midship perpendiculars, or timbers, the base line or upper edge of the rabbet; above which, both in the sheer and body plans, all heights are set up; as it should be observed, throughout the whole of laying off, to have as few lines as possible, that there may be the less confusion.

The body plan in Plate I. is placed on the left hand, as, by so small a scale, it would otherwise have appeared confused, especially to a beginner; although on the floor, where it is enlarged, its lines are easily distinguished.

The lower height of breadth line may next be taken from the sheer-plan, by transferring its heights at the respective timbers to the body plan, above the base line, and striking horizontal lines at each of those heights.

Proceed to lay off the main half-breadth line, on the half-breadth plan thus; take, from the table of bodies, the main half-breadth of each timber, and set it upon its corresponding timber from the line A B, now representing the middle line of the half-breadth plan; then, by pinning a batten to those spots, form the fair curve of the main half-breadth line. To end this line, the half thickness (or siding) of the stem must be set off from the middle line of the body plan as obtained by halving what is given in the table of dimensions. Then take the height in the sheer-plan where the lower height of breadth line intersects the aftside of the rabbet of the stem, and transfer it to the middle line of the body plan; and, at that height, take the half thickness of the stem from the middle line, and transfer it to the half-breadth plan, parallel to, and above, the line A B, or middle line. Then square down upon the line last drawn, the aftside of the rabbet of the stem at the lower height of breadth, and that spot ends the line. By pinning a batten to this and the other spots set off, we form the fair curve of the main half-breadth line.

The lower height of breadth lines having been struck across the body plan, we may next take off the main half-breadth line and transfer it to the body plan. This is done, by taking off the main half-breadth at each timber in the half-breadth plan, and setting it off from the middle line of the body plan upon its corresponding heights.

Now, by taking the length of the lower breadth sweeps from the table of bodies, or as represented by the line so marked on the half-breadth plan, we set them off from the main half-breadth at their corresponding heights on the body plan; thus shortening the height of breadth lines, on the body plan, to the different lengths necessary to sweep a portion of each timber below their respective lower breadth lines, as represented in the body plan, by the line termed *boundary of the lower breadth sweeps.*

Describe, in the sheer-plan, the heights of the centres for the radius of the floor sweeps, taken as before directed from the table of bodies; and, because the lengths of the floor-sweeps are various, in the 80 gun ship the height of their centres must be set up from the line A B, and those respective heights are to be set up above the centre height given at ⊕ in the body plan.

Then, from the table of bodies, the rising half-breadth (or narrowing of the floor-sweeps) may be set off from the middle line A B, on their corresponding timbers in the half-breadth plan, and form the fair curve marked *rising half-breadth;* then, from this line, set off the several half-breadths of the rising from the middle lines in the body plan, upon the rising breadth at ⊕ and strike up perpendiculars, lines at each half-breadth. Upon these perpendiculars set up the height of the centre of each floor-sweep, respectively, from the sheer-plan, above the centre height at ⊕; by which you will obtain several spots through which if a line be drawn, it will form *the boundary and centres of the floor-sweeps.*

Next set off the second diagonal, or ribband near the floor head, from the table of bodies; and, also, the several lengths given upon that diagonal from the middle line. From the centre on the boundary of the floor-sweeps to the spot on the diagonal which corresponds with its respective timber, you obtain the length of every floor-sweep; by which that portion of the body may be swept at the floor heads. But, if the body of the ship be constructed so that the radii of the floor-sweeps are of *one* given length, you may, *at once*, set up their centres in the body plan above the given rising line in the table of bodies.

The other diagonal lines should next be struck in the body plan, taking their heights and distances from the table of bodies as marked Diag. 1, Diag. 2, Diag. 3, Diag. 4, Diag. 5, and Diag. 6, in the body plan. Then set off, from the middle line, down each diagonal line, the several lengths as given in the table of bodies: now pin a pliable batten to the spots set off on each diagonal, and passing from the back of the lower breadth sweep to break in fair with the back of the floor-sweep and thence down to the side of the keel at the rabbet: thus, set off the half breadth of the keel from the table of dimensions parallel to the middle line in the body plan, at the base line, and as much below it as the keel is deep. Then set off the half thickness of whatever the keel tapers forward, from the middle line in the half-breadth plan; and, at every timber, take off the said half thickness of the keel and transfer it to the body plan, setting it off from the middle line along the base line. Then, with a pair of compasses, opened to the thickness of the plank of the bottom, fix on and begin the half thickness of the keel and describe an arch towards the middle line, cutting the base line. Now finish the heel of every timber on the back of its respective arch. Where the rabbet of the keel and stem rises, take the height above the line A B, in the sheer-plan, to the intersection of each timber at the ticked line in the middle of the rabbet, and set them up, above the base line in the body plan, upon the ticked line that is parallel to the thickness of the bottom plank, within the half thickness of the stem, which gives the spot that ends the heels of those timbers that rise above the straight line of the rabbet.

The square body being formed, and the timbers below the main breadth run off exactly, conformably to the dimensions given, proceed to lay off some fore and aft lines, in a different direction from the diagonal lines, in order to prove the fairness of the body. Set up and strike, in the body plan, several horizontal lines at equal distances above the base line, and call and distinguish them by Wat. 1, Wat. 2, Wat. 3, Wat. 4, Wat. 5. This we would always recommend to be done in the mould loft, although the water lines of many ships are not parallel with the line of the keel as they are in the 80-gun ship; for, unless they are parallel with the keel, they cannot answer any operation in the laying-off.

Now lay a batten, with a thin edge, well with the line, say Wat. 5, or the upper one; keeping one end of the batten fitted well against the middle line, and mark off, with thin chalk, all the intersections of the timbers upon the edge of the batten. Then set off the different spots from the line A B, or middle line, upon their corresponding timbers in the half-breadth plan. Again, by pinning a batten to those spots, and another spot made at the ending, a fair curve line will be made by the water line 5.

Observe, when the batten is pinned to the spots, to look along it strictly, and see that its edge will produce a fair line *.

Now, to end the water-lines upon the half-breadth plan, take the height of Wat. 5, from the base-line in the body-plan to where it intersects the half thickness of the stem, and set that height up square from the line A B in the sheer-plan, to intersect the rabbet of the stem, striking there a horizontal line to the adjoining perpendicular, and mark it Wat. 5. Set up the heights of all the water lines in the same manner. Then take the half thickness of the stem, square from the middle line in the body-plan, at Wat. 5, and set it above and parallel to the line A B (or middle line) in the half-breadth plan; again, square down the aft-side of the rabbet of the stem at Wat. 5, in the sheer-plan, upon the line last struck, or half thickness of the stem in the half-breadth plan; and that spot is the ending of water line 5.

The water lines all end in the same manner except the lower ones, where the rabbet opens; to end which (say Wat. 2,) instead of taking the half thickness of the stem, as before, take the inside of the rabbet square from the middle line in the body plan (at Wat. 2,) and set that off above, and parallel to, the middle line in the half-breadth plan. Then square down the middle of the rabbet of the stem, at Wat. 2, in the sheer-plan, upon the line last struck, or half thickness of the stem at the inside of the rabbet, in the half-breadth plan; and that spot will be the ending of Wat. 2. Where the rabbet does not open, end the water lines against the side of the stem at the aftside of the rabbet; and, where the rabbet does open, end them at the inside of the rabbet.

The water-lines being run, we may now see if the body requires any alteration; as, should any

* This is a general observation, which must be attended to throughout; and therefore need not be repeated.

of the timbers be found either too full or too sharp for the water-lines, they must be altered agreeably thereto. For the water-lines cut the timbers in the body-plan so obliquely, as to point out readily any unfairness; at the same time, act with the greatest caution, in order to preserve the true shape of the body as nearly as possible.

We may now prove the heels of the timbers, that they may require no alteration afterwards, which must be done by the bearding-line; therefore, set off, from the middle-line in the body-plan, the half thickness of the outside of the foremost dead-wood, and drop a perpendicular, parallel to the middle line. This line will represent the bearding line in the body plan. Then fix a batten well with the bearding line, in the body-plan, keeping the lower end fitted to the base-line; then mark off all the intersections of the timbers, and set them up from the line A B in the sheer-plan, on their corresponding timbers. Pin a batten to the spots set off, and it will form the line, marked bearding-line, on the sheer-plan.

We have made the half thickness of the stem at the head the half thickness of the dead-wood, or distance of the bearding-line from the middle line in the body plan; but it may be made more, as it would thus shorten the heels of the timbers when run down to the stepping or bearding-line.

The heels of the timbers being found to agree with the bearding-line in the body and sheer-plans:

The water lines, being horizontal sections, proceed to prove the timbers again, by perpendicular lines or vertical sections; for, from these sections, we may depend upon the fairness of the body. Now, strike, in the body plan, perpendicular lines between three and four feet asunder, equally from the middle line, and mark them Pr. 1, Pr. 2, Pr. 3. Pr. 4. Then place a thin edged batten with the end fitted well with the base line, and the thin edge well with Pr. 1. (or that next the middle line in the body plan.) Mark the intersections of the timbers, and transfer them to their corresponding timbers above the line A B in the sheer-plan; then set off the same perpendicular sections on the half-breadth plan, parallel to the line A B, at the same distance from the line A B, as they are from the middle line in the body plan; and, wherever these perpendicular lines, on the half-breadth plan, intersect the water lines on the same plan, square them to their corresponding water lines in the sheer-plan; and, where they intersect the main half-breadth line in the half-breadth plan, square them up to the height of breadth line in the sheer-plan, which gives the ending of the perpendicular sections on the height of breadth line. Now pin a batten through all the spots in the sheer-plan, and you will find the fair curves marked Pr. 1, Pr. 2, &c. which represent the shape of the body in a perpendicular direction.

To prove the bow, or close forward, square up an imaginary or proof timber between the foremost timber X and the foremost perpendicular; then, with a batten, take the heights of the perpendicular sections and lower height of breadth line, in the sheer-plan, and set them off in the body plan, upon their respective perpendiculars. Now take off its intersections with the water lines and main half-breadth, from the half-breadth plan, and set them off upon their corresponding lines in the body plan.

Again, take the radius or length of the main breadth sweep of this proof timber on the half-breadth plan, and sweep the proof timber below its height of breadth on the body plan;

and, to end the heel of it, take the height up the stem where the proof-timber intersects the middle of the rabbet in the sheer plan, and set it up upon the inside of the rabbet in the body-plan. Pin a batten to the spots, and the proof-timber will be formed in the body plan.

Having now sufficiently proved the fairness of the body, we may proceed to lay off the diagonals on the half-breadth plan.

It may here be observed, that the diagonal lines standing square to the timbers, or nearly so, upon the body plan, are the least to be depended upon for pointing out any unfairness in the formation of the timbers; because they may really appear as fair lines upon the half-breadth plan while the body itself is unfair.

Strike, in the body plan, the diagonal lines, or ribbands for framing the ship, and for the places where the bevellings are to be taken. Then take a thin edged batten and lay its thin edge well with diagonal 5, (or the upper one) fitting one end to the middle line; then mark, on its edge, the intersections of all the timbers, and set them up, from the middle line of the half-breadth plan, on their corresponding timbers; and, to end it, take the height of the intersection of diagonal 5 with the half thickness of the stem in the body plan, and transfer it to the sheer-plan. There strike an horizontal line across the stem; and, where it intersects the aft-side of the rabbet, square it down to the middle line of the half-breadth plan. Then take the half thickness of the stem from the middle line in the body plan, in the direction of the 5th diagonal line, and set it off above the middle line of the half-breadth plan, upon the line last squared down, and that spot ends it. Now pin a batten to all the spots with the spot at the ending, and it will form the curved line marked diagonal 5, in the half-breadth plan.

The diagonal lines being run, in a similar manner, we shall, in order to avoid a confusion of lines, proceed with only one more, say diagonal 2 or ribband at floor head. Lay a batten, as before, along diagonal 2, fitting one end to the middle line on the body plan: mark the intersection of the timbers; then set them off on their corresponding timbers, from the middle line, in the half-breadth plan; and, as here the rabbet opens, end it. Thus, take the height of the intersections of diagonal 2, with the inside of the rabbet, in the body plan, and transfer that height up the stem in the sheer plan. Draw a horizontal line across the rabbet; and, from the middle line, in the body plan, take the intersection of diagonal 2 with the inside of the rabbet, in the direction of the diagonal line, and set it off above, and parallel to, the middle line in the half-breadth plan. Upon the line last struck, square down, from the sheer plan, the intersection of diagonal 2 with the middle of the rabbet, and that spot will end diagonal 2. A batten is now to be pinned round, as before, to form the curve of diagonal 2, and so on with the others.

It may now be readily observed that the ending of a diagonal line and a water line differs only in taking the half thickness of the stem or inside of the rabbet diagonally or horizontally, as the line extends.

The cutting down line may now be run in the sheer-plan, taking its heights from the table of bodies, and setting them up above the line A B, in the sheer-plan, on their corresponding timbers. A batten, pinned to the spots, will form the curve marked cutting down line, which also represents the foremost dead-wood, the upper side of which is limited by this line before the foremost floor-timber. The fore foot and boxing of the stem may now likewise be laid off from the draught.

The body being thus completed, below the lower-breadth line, we may proceed to finish the square body by laying off the top-side. Describe in the sheer-plan the top-timber line, by setting up the heights, from the table of bodies, above the line A B in the sheer-plan, upon their corresponding timbers; except that part of the top-timber line which comes on the curvature of the bow, as that is liable to be altered from the curve given in the draught, in order to give it the same appearance on the ship as in the draught. For, it should be remembered, that the line on the draft is a line rounding upwards on a plane; whereas the same line, on the ship, will be a line rounding forwards as well as upwards. The 80 gun ship, having a beak head, the top-timber line will alter but little, if any, because it does not go close forward to the stem; but, in order to see what little difference there may be, proceed to get in the lower edge of the wale (from the table of bodies) in the sheer-plan, and transfer those heights to intersect the corresponding timbers in the body plan, and run a line on the half-breadth plan from those heights. Then pin a batten round the last mentioned line, and mark on it the intersections of the timbers and the aft-side of the rabbet; then apply the batten to the wale line in the sheer-plan, keeping the stations of the timbers, as marked on the batten, well with the stations of the timbers in that plan, for several timbers afore dead-flat, wherever they will perfectly correspond. Now mark the new stations of the other timbers, from the spots on the batten, and likewise the new spot for the aft-side of the rabbet. Level those spots or alterations aft, till they intersect the places of their respective timbers on the sheer-plan, which will give the spots shewing the heights by which the wale line is to be raised at the respective timbers. The sheer may then be lifted in the same proportion and its heights transferred to the body plan.

This method of lifting the wale is introduced here merely by way of explanation, and not as a principle to be strictly adhered to; for, it is very evident, that, in the 80 gun ship, as well as in all full bow'd ships, it lifts the wale much too high close forward. The artist must, therefore, in this instance, be guided by his judgment. But it is always necessary to raise the sheer something more than is shewn in the draught upon the floor, because it generally requires it on the ship; and, were this not allowed, the knuckles of the timbers forward would be too low.

Proceed to get in the top-timber line, on the half-breadth plan, by setting off the top timber half breadth, from the table of bodies, on the corresponding timbers from the middle line on the half-breadth plan; then pin a batten to the spots, and it will produce the curve marked top timber half-breadth line.

Take the heights of the upper height of breadth line from the sheer-plan, and transfer them to the body plan, striking horizontal lines at every height. Then, upon the same plan, square up the main half-breadth from the lower to the upper height of breadth lines. Next take the length of the upper breadth sweeps, from the tables of bodies, and set them off towards the middle line, from the timbers, as squared up to their respective upper height of breadth lines; and describe arcs or sweeps upwards.

Take off the top timber half-breadth from the half-breadth plan, and set it off from the middle line on its corresponding heights in the body plan; then, by forming the hollow, or inflected curve, passing fair from the back of the upper breadth sweep to intersect the half-breadth spots set off on the top timber line, each top timber hollow may be kept parallel and continued up to the top of the side, which may be transferred from the sheer plan to the body plan, drawing a curve at the height of the timber heads and at the top timber lines, observing, that two or three of the foremost timbers have a very different curve.

Next, square from the middle line in the body plan, take the intersections of the heads of the timbers at the top side line, and set them off upon their corresponding timbers, from the middle line in the half-breadth plan ; seeing that it makes a fair curve. The fore body may now be said to be formed above the main breadth, by which the whole of the square body will be described in the body plan.

The heights of the upper sides of the lower sills of the ports may be run in the sheer-plan, from the sheer draught, and transferred to their corresponding timbers in the body plan; and their half breadth thence run in the half-breadth plan.

At the port-sill lines bevellings may be taken; and, as ships are frequently cross-spaled in the ports, the half breadth at the port-sill line is consequently wanted.

The correct height of the knuckles of the timbers at the beak head next requires attention; for, if they were carried too high, the sheer of the ship must be lifted ; or, if kept too low for the sheer, the timbers must be reduced to raise the knuckles, therefore determine what part of the sheer strakes shall come well with the knuckles; for, if we confine the knuckle at the under side of the sheer-rail, the upper side of which comes well with the upper side of the sheer-strake, the sheer rail being of much less depth than the sheer-strake, it will, consequently, bring the touches of the knuckles about the middle of the sheer strake, the fore shift of which must then be wrought, taking a large piece and much labour. It is best to make the inside of the lower edge of the upper sheer strake form the knuckles of the timbers. To do this, above the top timber line, in the body plan, square up perpendicular lines at the foremost timber X, and one or two abaft it; set off, likewise, the thickness of the sheer strake, parallel thereto, and level it into the timber at the lower edge of the upper strake. Then from the hollow of the timber square in the lower edge of the upper sheer strake from its outside; now draw in a line between the lower edge, as levelled out, and the square line last drawn, and that will determine the knuckle of X. Proceed, in the same manner, to find the knuckles of all the timbers abaft the beak head.

Observe, if there is only one sheer strake, or, if the lower edge of the lower sheer strake comes well with the knuckle, to level in the lower edge, as far as the outside of the plank, below the sheer strake or strakes; and, thence to the inside of the sheer-strake, draw a line between a square with the perpendicular line and a square with the hollow of the same timber, and that determines the knuckle of the timbers.

The square body afore dead-flat being now completed, we may proceed to lay off the after body or square body abaft dead-flat, but, shall only point out such differences as occur at the extremes of the ship, the midship part being similar in both bodies.

On the line A B, or upper edge of the rabbet, square up the after perpendicular to the left end of the loft, reserving sufficient room for afterwards laying off the side counter timber, if the length of the loft will admit of it. Now, take in, for the after body, as many of the perpendicular stations of the fore body as may answer to give shift for one or two timbers afore dead-flat. We have, in order to make it more clear, laid off the after-body upon another Plate, although, as we have before observed, on the floor it would be clear enough.

Proceed with the after-body, represented in Plate 2, as with the fore-body shewn in Plate 1, to strike a straight line, to represent the upper edge of the rabbet of the keel, and mark it A B. Square up, from this line, the after perpendicular; reserving, to the left hand, sufficient room for the after-body. Set forward, from the after perpendicular, the stations of dead-flat, and all the intermediate stations of the timbers, as (3), (5), 2, 4, 6, 8, 10, &c. taken from the tables of bodies, and one or two stations before dead-flat, as B, &c.

Having described the after perpendicular, and those at the joints of the frame timbers in the sheer-plan, strike in the aftside of the stern-post, taken from the draught or table of dimensions, and the aftside of the rabbet; and strike parallel thereto, on the foreside, a line to the thickness of the bottom plank.

Set up the lower and upper height of breadth lines, as taken from the draught or table of bodies, on their corresponding timbers in the sheer-plan, from the line A B, and run in curves as before.

Draw in the perpendicular and base lines of the body-plan, by squaring up two perpendiculars to the main half-breadth at dead-flat, from the line A B to the left hand, as shewn in Plate 2. The middle line will be that on the right hand. In the mould-loft, the side line of the fore-body makes the middle line of the after-body, the bodies towards the lower part crossing each other, which would appear very confused on the Plate.

The lower height of breadth line may now be taken from the sheer-plan, and the heights transferred to the body-plan, striking horizontal lines at each height.

Run in the half-breadth plan, the main half-breadth line from the draught or table of bodies. To end this line in the after-body, square down its intersection at the side counter-timber in the sheer-plan to the half-breadth plan, and where it cuts that line, there it stops.

The lower height of breadth lines having been struck across the body-plan, take off the main half-breadth line, from the half-breadth plan, and transfer it to its corresponding height of breadth lines in the body-plan, from the middle line. Run in upon the half-breadth plan, the lengths of the lower-breadth sweeps of the after-body, taken from the table of bodies, and form the fair curve there so called. Then take those lengths from the half-breadth plan, transfer them on their heights, respectively, in the body-plan, and sweep the timbers below the breadth-line.

Proceed now to obtain the length of the floor-sweeps in the after-body exactly in the same way as directed for the fore-body, by means of the rising-line and diagonal at floor-head.

Strike in the diagonal-lines; and, on them set down, from the middle-line, the several lengths given in the draught or table of bodies, for forming the timbers in the plan of the after-body. Then, by pinning a batten to the spots set off, and round the back of the lower-breadth and floor-sweeps, continuing it to the side of the keel, the timbers will be formed along the midships; but, when the timbers begin to rise, or open the rabbet, the lower part will end in the inside of the rabbet, or the thickness of the bottom within the side of the keel. Those timbers which come near the after-end of the keel must be ended, by setting off the half-thickness of the keel at the stern-post, in the half-breadth plan, describing the tapering of the keel; and, within the half-thickness of the keel, set off the thickness of the bottom plank; then, at the corresponding timbers, take off the half-breadth to the inside of the rabbet, and set it off on the base-line from the middle-line in the body-plan; letting every timber end where the inside of its respective rabbet intersects the base-line.

The square body being formed to the dimensions, strike horizontal lines across the after-body at the same height as in the fore-body, and mark them Wat. 1, 2, 3, 4, and 5. Then proceed to run them in the half-breadth plan, as there directed; but, to end them, strike, in the plan of the after-body, half the thickness of the stern-post athwartships from the middle line; and, within it, a parallel line to the thickness of the bottom plank; which is the inside of the rabbet. Then take the height of the water-lines where they intersect the half-thickness of the stern-post, and transfer them to the stern-post in the sheer-plan, above the line AB, striking horizontal lines. Square down upon the line AB, or middle line of the half-breadth plan, where each water-line intersects the foreside of the rabbet in the sheer-plan; but, where the rabbet opens, square down the intersection of the water-lines with the inside of the rabbet, which is represented, in the sheer-plan, in the middle of the rabbet at the wing-transom, and about three quarters of an inch before the aftside of the rabbet on the keel, or line AB. On the lines last squared down, set off, from the line AB, (or middle line of the half-breadth plan,) the half-thickness of the post, taken in the direction of the line from the body-plan, where the rabbet does not open, and to the half-thickness at the inside of the rabbet where it opens. Those spots will end the water-lines on the half-breadth plan.

The water-lines being run and made fair in the after-body, examine whether the body or timbers want any altering to the water-lines; for, as observed before, with respect to the fore-body, the water-lines must be abided by; because ribband-lines, when run, may appear fair, although the true shape of the body, on an horizontal surface, may be unfair. The body, as given in the table, and water-lines, being made to correspond, proceed to prove the heels of the timbers by the bearding-line; thus, set off, in the body-plan, the half-thickness of the dead-wood, by dropping a perpendicular to the base line from the head of the stern-post. Then fix a batten well with the direction of this line, keeping the lower end well with the base line. Mark upon its edge the intersection of the timbers; then set them up to their corresponding timbers from the line AB in the sheer-plan. Pin a batten to the spots, and it will form a curve to break in fair with the foreside of the rabbet of the post. This curve will represent the bearding-line in the sheer-plan. The heels of the timbers being found to agree with the bearding-line, from the fairness of its curve, proceed to prove the timbers by perpendicular or buttock lines. Strike, in the body-plan, four or five lines, perpendicular to the base line, about three feet asunder, or equally divided between the outside of the wing-transom and bearding-line, and mark them Buttock 1, 2, 3, 4, 5. Then, with a thin-edged batten, take the heights of the timbers above the base line upon each buttock line, and set them up upon their corresponding timbers above the line AB in the sheer-plan. Where the buttock-lines intersect the water-lines in the half-breadth plan, square them up to their corresponding water-lines in the sheer-plan; and, if correct, the same water and buttock lines will be found to intersect on the sheer-plan in that perpendicular.

To end the buttock-lines, the upperside of the wing-transom and margin-line must be represented in the several plans. Set up the height of the wing-transom from the table of dimensions, above the line AB in the sheer-plan, and strike a horizontal line at the stern-post; set up the same height above the base-line in the body-plan, and strike a horizontal line, across the body, from its middle line; thence set off the half-breadth of the wing-transom, taken from the table of dimensions, and, at that place, set down the round of the wing-transom. Now, form an arch to represent the round-up or upperside of the wing-transom, and set off, below this curve and parallel to it, a sufficient depth for the tuck-rail or margin-line. Below the horizontal line, at the height of the upperside of the wing-transom, in the sheer-plan, set down the round of the wing-transom, and strike another line, parallel to it. Then, in the half-breadth plan, represent the round-aft or aftside of the wing-transom, thus; square down, from the sheer-plan, the foreside of the rabbet of the post, at the upperside of the wing-transom at the middle line, and, upon the line squared down, set off the half-breadth of the wing-transom from the line AB (or middle line).

At the half-breadth of the wing-transom, on the half-breadth plan, set forward the round-aft of the wing-transom, and form an arch thence to the middle line. Square up the touch, or angle made by the wing-transom, at the side, from the half-breadth plan to the lower horizontal line last struck in the sheer-plan; and, from the spot, strike a right line to the point where the height of the wing-transom at the middle line intersects the foreside of the rabbet; the line last struck represents the upperside of the wing transom in the sheer-plan.

The margin line may now be described in the sheer-plan, thus; take the depth of the margin line from the body-plan, and set it off below the upperside of the wing-transom last shewn in the sheer-plan; strike a line parallel to it, which will shew the height of the margin line in the sheer-plan. Then join the two lines, representing respectively the height of wing-transom and margin line on the sheer-plan, by a line drawn parallel with the foreside of the rabbet of the post. The margin line must now be shewn in the half-breadth plan, by squaring it down from the sheer-plan, and making it parallel to the aftside of the transom shewn in the half-breadth plan; the distance, however small, being equal to the rake of the rabbet in the depth of the tuck-rail or margin.

The margin line being shewn in every plan, we may proceed to end the buttock lines in the sheer-plan, thus; take off the distances of the buttock lines square from the middle line in the body-plan, and set off the same from the middle line AB in the half-breadth plan, striking lines, parallel thereto, from the aftside of the wing-transom to the after square timber, by which the buttock lines will be represented in the half-breadth plan; then, where these buttock lines intersect the margin line in the half-breadth plan, square up spots to the margin line in the sheer-plan, which spots will give the true ending of the buttock lines; now pin a batten to the spots before set off and to that last squared up at the ending of the buttock lines, which will produce fair curves representing the body cut in that direction in the sheer-plan.

Then, if the buttock lines prove fair, the timbers in the after-body will be fair; and, likewise, the after-part of the water lines in the half-breadth plan: but, if the buttock lines, to be made fair curves, require alteration from the spots before set off, then must the timbers be altered accordingly; and, consequently, the water lines. But now, to prove the fairness of the buttock, or body close aft, strike in one or two imaginary or proof-timbers, equally between the after-timber and wing-transom at the side, represented by the ticked lines in the sheer-plan, Plate 2. Fit a thin-edged batten to these lines, and one end well with the upper edge of the rabbet or line A B; mark on the edge the intersections of all the buttock lines and bearding line; then set up those heights in the body-plan, above the base line, upon each corresponding buttock line and bearding line; take, also, the intersections of the water-lines with the proof-timbers in the half-breadth plan, and transfer them to their respective water lines in the body-plan; but, as these timbers cross the stern-post, we must, to find their heels, take the heights where they intersect the inside line of the rabbet on the sheer-plan, and set them above the same line, in the body-plan, to intersect the inside of the rabbet represented there; now pin a batten through the spots before set off, and this at the heel will form the ticked timbers shewn in the body-plan, and will discover whether any alteration be necessary abaft.

Having now sufficiently proved the fairness of the after-body, we may proceed to lay off the diagonals on the half-breadth plan; that is to say, the diagonals to which the ribbands are to correspond, as observed for the fore-body, thus; fit a thin-edged batten, say to diagonal 5, or ribband at the third futtock-head; let one end be kept well at the middle line in the body-plan, and mark on its thin edge the intersections of the timbers which are to be set off on their corresponding timbers from the middle line A B in the half-breadth plan.

The ribband at the third futtock-head, or diagonal 5, coming upon the wing-transom, to end it, requires its distance to be taken square, from the middle line in the body-plan, to where it intersects the margin line; and, that distance to be set off square from the middle line A B, in the half-breadth plan. To intersect the margin line there, continue its intersection out parallel to one of the square timbers, or square from the middle line A B; then take the distance from the middle line, in the body-plan, to its intersection with the margin line in the direction of diagonal 5, and set it off square from the middle line A B, in the half-breadth plan, on the line last squared out, and that spot gives the ending of diagonal 5. Then pin a batten to the spots before set off, and this spot at the ending, and diagonal 5 will be represented in the half-breadth plan.

To prevent a confusion of lines, we shall only complete diagonal 2, or ribband at the floor-head. The process is the same as before; but, to end it as it opens the rabbet, take the height of its intersection at the inside of the rabbet of the post, square from the base line in the body-plan, and set it off in the same direction from the line A B in the sheer-plan, to intersect the inside of the rabbet of the post; then square down this intersection, to the middle line of the half-breadth plan: again, take the half-thickness of the post, in the direction of the said diagonal, to the inside of the rabbet, and set it off from the middle line A B, on the line last squared down in the half-breadth plan, and that spot will end it.

Where the rabbet does not open, the heights of the diagonals, where they intersect the half-thickness of the post in the body-plan, are transferred to intersect the foreside of the rabbet in the sheer-plan, and thence squared down to the middle-line A B in the half-breadth plan. The half-thickness of the post is then diagonally taken, from the middle line in the body-plan, and set up from the middle line AB, in the half-breadth plan, upon the foreside of the rabbet last squared down; thus ends any diagonal when the rabbet does not open. The diagonals may now be considered as run.

The cutting-down line may next be run in the sheer-plan, by setting up the heights given in the tables of bodies, and pinning a batten thereto. This line also represents the after dead-wood, the upperside of which it limits.

The after-body being completed, under the lower-breadth line, proceed to finish the after square-body, by laying off the topside.

Describe, in the sheer-plan, the toptimber line and topside line, taking their heights from the tables of bodies, and setting them above the line AB, in the sheer-plan, on their corresponding timbers. Pin a batten to the spots set off, and produce the curves marked toptimber line and topside. But where mould-lofts are not broad enough, the heights must be set up with such a number of feet added as may be convenient.

Transfer the heights of the upperbreadth line, toptimber line, and topside line, from the sheer-plan to the after body-plan, striking horizontal lines across the body at each height; then square up the main half-breadths, from the lower to the upper height of breadth lines, in the body-plan.

Run the toptimber half-breadth line, in the half-breadth plan, from the tables of bodies, and pin a batten to form the fair curve marked toptimber half-breadth line. Then transfer those half-breadths to their corresponding lines in the body-plan by making of dots.

Now take the length of the upper-breadth sweeps, which is the same as in the fore-body, and describe arcs above each corresponding upper height of breadth line in the body-plan; then form an easy hollow or inflected curve, as in the fore-body, to pass fair from the back of the arcs already swept, so as to intersect the spots at the toptimber half-breadth. The hollow or tumbling-home, as at dead-flat, should be preserved the same in both bodies, and all kept parallel, except quite forward and aft, and so continued to the top of the side.

The heights of the upper sides of the lower sills of the ports may be run in the sheer-plan, from the sheer-draught, forming the curves marked upper port-sill line and lower port-sill line. Transfer those heights to their corresponding timbers, in the body-plan; and thence transfer their half-breadths to the half-breadth plan, and form the curves, there marked upper port.sill line and lower port-sill line, ending them similar to a diagonal line. We have only run the upper port-sill line in our draught, in order to avoid confusion in the half-breadth plan.

The sheer, half-breadth, and body plans are now laid off ready for forming the different parts of the ship depending on the square bodies.

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§ 2. OF THE MOULDS NECESSARY TO BE MADE FROM THE PARTS WHICH ARE ALREADY LAID DOWN, AND OF THEIR PRACTICAL APPLICATION TO THE MOULDING OF THE TIMBERS. *(Plate 1.)*

The square bodies being laid down, we may now proceed to make the moulds, in order to get the timbers cut as far as the square timbers extend.

The first mould may be made to the FOREFOOT (Fig. 1.), or foremost piece of keel, which is limited on the after-part of the upper side by the upper edge of the keel, and, on the fore-part of the upper side, by the diagonal ticked line that breaks forward into the aftside of the stem, by the fore-part of the forefoot, and the lower part by the underside of the keel. The after end may extend to about two frames abaft, where the curve of the rabbet breaks into a straight line. The stations of the timbers may all be marked upon the mould, and likewise the direction of the straight line representing the upper edge of the rabbet.

A mould may be made to the FOREMOST DEAD-WOOD (Fig. 2, though it is seldom done), the upperside of which is limited by the cutting-down line, and the lower part by the upperside of the forefoot, marking on it all the stations of the timbers.

The mould made for the AFTER DEAD-WOOD (Fig. 3.) is limited on the upper part by the cutting-down line, on the lower part by the upper edge of the keel, the after end by the foreside of the inner post, and the foremost end by the aftside of the after floor. This mould is generally made to regulate the whole of the after dead-wood when the different pieces (as shewn by the ticked lines) are tabled together; it contains, likewise, the mould for the *dead-wood knee;* and, also, one for the piece of dead-wood that comes upon it. Upon the after dead-wood mould are fastened battens, with one edge straight, to correspond with the stations of the square timbers; the other edge is formed to the moulding edge of the timber, which gives the half-thickness of the dead-wood below the stepping or bearding-line marked upon the mould. To make this mould more convenient, let it be in two parts, separating lengthways at the line shewn at about half of its depth.

We may now proceed to the MOULDS OF THE SQUARE-TIMBERS, which are to be made from the body-plan; in order to which, we must first set off the scantling of the timbers, the moulding way, at every head, at dead-flat, and, by drawing a curve to pass through the several spots, the scantling-line, or inner edge of timber dead-flat, will be described, as the ticked line in the fore body-plan, Plate I.

THE MIDSHIP FLOOR-MOULDS may now be made, proceeding in the following manner. (Fig. 4.). Make a mould, the outside of which shall fay to the timber dead-flat, from about a foot above the floor-head down to where the height of the rising, when levelled out, shall intersect; and thence, to about a foot beyond the middle line, the mould to fay to the horizontal line or rising at dead-flat. The inside of the mould, at the upper part, must be made to the scantling-line, and the inner part may run parallel to the outside. Then, upon this mould, when lying in its place, mark the middle line of the body-plan, the station of the floor-head, second diagonal or floor-ribband, and lower diagonal. At the last place we shall find the mould not to fay to the line of dead-flat; we must, therefore, apply a small square to the outside of the mould, in order to get the true station of the lower diagonal; this being done, we may provide another mould, exactly similar to the former, with the same marked upon it, only observing to mark the contrary side. In the next place, provide a batten, about four inches wide, and of a length sufficient to take the height of the cutting-down line at the after floor-timber; then fit one end to the cutting-down line, and mark on the batten where the upper edge of the rabbet intersects at every timber from dead-flat as far forward as the foremost floor, and from dead-flat as far aft as the after-floor in the sheer-plan; observing to mark the after-body on one side, and the fore-body on the other. This batten is called the *cutting-down batten.*

Now provide a square, the arm of which shall be sufficiently long to take the height of the rising, a little abaft the bearing of the ship. Apply one arm of this square to the horizontal line at the rising of dead-flat, in the body-plan, and, upon the other arm, mark the base line or upper edge of the rabbet: then, in the same manner, apply the square to every one of the horizontal lines at the rising of each timber, marking the base line on the other arm of the square; and marking, also, the fore-body on one side and the after-body on the other; which being done, it is termed the RISING-SQUARE. It is then customary to make a slight mould to that part of the floor extending from the side of the keel to the back of the floor-sweep, which the floor-mould does not take. This is termed the FLOOR-HOLLOW, and upon it must be marked the side of the keel, and the lower diagonal. Sometimes, from the back of the floor-sweep to the side of the keel, the timber is finished by a straight line. The floor hollow mould is then, of course, not wanted.

The floor-moulds of dead-flat may now be applied to the body-plan, to see how many floors may be moulded by them. Were all the radii of the floor-sweeps of one length, all the floors that sweep at the heads might, of course, be moulded by these moulds: but, if the radius of each floor-sweep increases in length as the floors go forward or aft (which is generally the case in the present mode of construction, particularly in the Navy,) the moulds of dead-flat will only mould the floors in the fullest part of the body.

Take one of the floor-moulds, and lay it on the fore body-plan, beginning from the foremost floor that is swept, applying the mould to every floor till the head of the mould will fay to the swept part of the floor below the head, the straight part of the mould at the same time lying in an horizontal position, which will be the farthest from dead-flat that can be moulded by the moulds of dead-flat; (this, in the eighty-gun ship, we shall find to be F in the fore-body and 14 in the after-body;) then, upon the mould, as it lies in the above position, mark on it the stations of the floor-head, second diagonal or floor-ribband, and lower diagonal; likewise the middle line of the body-plan, marking the name of each floor at its respective place. Now take the rising-square, and apply one arm of it to the under part of the mould; and, on the other arm, mark the base line, or upper edge of the rabbet in the body-plan, marking there the name of the floor also. This method of crossing, or marking, the rising-square, is only necessary when the radii of the floor-sweeps differ in length, as in the body of the eighty-gun ship; for, until the floor-mould is made, and thus applied to the body-plan, it cannot be ascertained what height the rising of each floor will be. This being done, proceed to place the mould to the next floor-timber, and act in the same manner as before, and so on with every intermediate floor between that and dead-flat. In applying the mould to the different floors, the respective stations of the floor-head, floor-ribband, lower diagonal, and middle line, will fall regularly between the stations of dead-flat and the farthest floor marked on the mould, which will prove that the body is laid down fairly in that part; then take the other mould, and mark all the stations upon it, similar to the first, observing to mark it on the contrary side.

The floor-moulds are now only marked on one side, which is for the fore-body; take, therefore, one of them, and apply the blank side upwards to the after-body, marking on it as many floors as we shall find it answer to, by acting in the same manner as directed for the fore body, which we shall find to be from ⊕ to 14, as before observed; and, likewise, mark the blank side of the other mould answerable thereto. These two moulds will then be finished; having all the floor-timbers marked upon them that can be moulded by them. There must also be a *floor hollow mould*, or moulds, made to complete each floor, to the side of the keel that is marked on the floor moulds.

The moulds being made for moulding the midship-floors, we may proceed to make moulds to those afore and abaft, which may all be upon one mould as follows (Fig. 5.). Provide a thin board, which must be made to fay to G, (the next floor timber where the midship mould takes) from the floor head down to the side of the keel, and make it of a parallel width, about four inches. Provide another board, fay it to the after floor 28, from the head to the side of the keel, and make it to the same width. Then lay them both in their places, and nail a piece of board made parallel to the half breadth of the keel, its midship edge well with the middle line; the lower end of this must be cut square, and be well with the base-line: the upper end is to extend, at least, above the cutting-down of the after-floor. Now nail a strait batten, about four inches wide, at the floor-head, from one to the other; the upper edge well with the direction of the floor-head. Let battens of the same width be nailed across, with their upper edges kept well with the floor ribband, and one at the lower diagonal, and as many between as may be thought necessary. Let these battens be about three inches wide, which will distinguish them from the former ones, as they shew the proper stations of the diagonals, and, likewise, the direction of the floor-heads. Then, upon these cross-battens, must be marked the intermediate floors; and their cutting down must be marked on the board, in the middle, from which board to that representing the after floor, fix one or two battens as braces. There must be outside pieces and battens put together, exactly in the same manner, for the other side of the ship; and the same lines correctly transferred to the other side. These two moulds may then be united together, at the middle line, by hinges; so as to shut together and be more handy for use. The mould may now be said to be finished for moulding the floors of the fore body.

We may next lay the blank side of the mould upon the after body; and, if the diagonal lines be similar to those of the fore body, the after floors may be marked across the mould as before; but, if the diagonal lines be not similar to those of the fore body, it will then be best to make another floor mould for the after body. Moulds, similar to the latter, are mostly made to the midship floors, and with a horizontal line, or thin board, across the mould about one foot or eighteen inches above the upper side of the rabbet, as shewn in Fig. 5, which being rased correctly across each floor timber, will answer to let them down and level the floors by.

The floor moulds being completed, we may now proceed to the LOWER FUTTOCK MOULDS, beginning with dead-flat, (Fig. 6.). Make a mould to the line of dead-flat in the same manner as the first floor mould, only letting the upper part of the mould be long enough to reach about one foot above the first futtock-head. The most exact way is to mark out this mould below the floor-head by one of those floor moulds; then lay it to the line of dead-flat, and mark upon it the side of the keel, the lower diagonal, second diagonal, third diagonal, or lower futtock ribband,

and lower futtock head; then, at the side of the keel, take the distance from the under side of the mould to the base line, and mark the spiling. The mould may next be tried to the adjoining timbers farther forward, and those to which it will fay from the lower futtock-head to the lower part of the floor-sweep, may be moulded by the same mould, and their respective diagonals and head be marked thereon, with the line for the side of the keel; and, likewise, the spiling there, from the upper edge of the rabbet to the under side of the mould: the mould will then be finished on that side, and the same marks and spilings must be transferred to the other side; it will then mould the timbers which are marked on it for both sides of the ship. Proceed, in the same manner, to make another mould for the after body; marking as many timbers on it as the mould would fay to, and observing the same restrictions as before.

The LOWER FUTTOCKS, which are before and abaft those on the midship mould, are contrived various ways; some put them all upon one mould, made with battens, as Fig. 7. To moulds made in this manner, in order to prevent racking, it is necessary to place battens at angles with those that lie in the direction of the diagonals. We cannot, however, recommend this method of making moulds, as it is liable to some error; for the workmen, in pinning the batten to the given spots are sometimes incorrect, and there will consequently be a deviation from the true moulding. The best and surest way is, to make one slight mould of seasoned stuff, to every two timbers; the outside edge faying to the frame timber, and the inside edge to the filling timber, (Fig. 8.) but, if saving of stuff and time be considered as an object, make the edges of the mould fay to two frame timbers, and set down spilings to the filling-timbers adjoining, at every diagonal, and also at head and heel, as Fig. 9.

The SECOND FUTTOCK MOULDS may be next made. Make a mould to the line of dead-flat, to extend from the floor-head to the second futtock-head, and let the inside be made to the scantling-line; mark, upon this mould, the second futtock-heel, the third diagonal, first futtock-head, fourth diagonal, or second futtock-ribband, and second futtock-head; apply the mould to the other timbers afore dead-flat; and, as many as it will conveniently take, by being moved upwards or downwards, mark thereon; then transfer the whole to the other side. Make another, also, to the after-body, to the scantling line, marking the same diagonals, &c. as on the other. Then the moulds for the timbers, which are not upon these two moulds, both afore and abaft, may contain two timbers upon one slight mould, (Fig. 8.). Upon these moulds must also be marked the diagonals, heads, and heels; and, it will be likewise necessary, to mark in figures, at every head, &c. the scantling or size of the timber the moulding way, as in Fig. 8. Frame-moulds are made by some to take all the second futtocks at once in the square-body, as Fig. 10.

Indeed, the first description of moulds, (such as Fig. 4 and 6.) will answer but to little purpose except in vessels whose timbers are nearly whole moulded; but, as this mode of construction has been, of late years, very justly exploded, and is now very seldom used, except in boats of burthen, (See the Long Boat, Plate 29.) here alone, the main breadth being mostly at a parallel height with the rising, and its radius of one length, all the timbers in the square bodies may be moulded by the floor mould and lower futtock mould as first described in Fig. 5 and 6.

Proceed now to the THIRD FUTTOCK MOULDS, which, as they are exactly similar to those of the second futtocks, require no particular description, only observing that they come on the heads of the lower futtocks, and extend to the third futtock-head; we must therefore mark on them the third futtock heel, the fourth diagonal, second futtock-head, fifth diagonal, or third futtock ribband, and third futtock-head. (Fig. 11.)

The FOURTH FUTTOCKS next demand our attention; the making of moulds for which requires a little consideration; for, as they are the longest futtocks in the ship, and, likewise, of a very different shape from any of the rest, they are, consequently, more troublesome to mould. Some artists employ more stuff and time about these moulds than all the others in the ship; but we shall shew a method that is practised by the more skilful, whereby may be moulded, by one mould, nearly all the fourth futtocks in the fore body. Let the mould be made to the line of dead-flat (Fig. 12.), in length from the second futtock-head to the fourth futtock-head, or top of the side, and two or three feet longer, to take the timbers afore dead-flat. The inside of the upper part is to be made to the scantling-line. Lay the mould in its place, and mark upon it the head, or top of the side, the upper and lower heights of breadth, and port-sill lines, or level lines, between the upper height of breadth and topside and toptimber line; and, below the breadth, the third futtock-head, the fifth diagonal, and the heel, which will complete it for dead-flat. Place the upper part of the mould to the foremost timber of the square-body, and we shall find it to fay from the main breadth upwards (as it will likewise to all the timbers between this and dead-flat, in consequence of the radii of the upper-breadth-sweeps being all of one length); then, while the mould is in this position, if it covers that part of the timber from the main breadth downwards to the fourth futtock-heel, the fourth futtock of this timber may be moulded by this mould, as it may then be consequently marked on it; but, if not, then the mould must be moved to the next timbers aft, placing it after the same manner, until the timber is found to which it will mould, as described above: then mark on the mould, the lower and upper breadths, topside, &c. of each timber. While the moulds lie well to the timber above the breadth, take the third futtock-mould of each timber respectively, keeping the heel of the third futtock-mould well with the third futtock-heel of each timber; then mark it by this on the fourth futtock-mould, and also mark the diagonals, &c. from it as it lies.

Now see if the mould fays to the line of the timber at the head (as the tumble home is less forward and abaft than in the midships) and where it does not fay, measure the distance from the mould to the line of the timber, on a square, and set it down in figures at the head marked on the mould; this being done to all the intermediate timbers, the mould may be said to be complete on that side; when so done, it will be necessary to have a small hole made square through the mould at every sirmark, upon every timber, by which means the true shape of the lines and places of the sirmarks may be transferred to the other side of the mould, and likewise upon the timbers when moulding.

In the same manner must be formed another mould, made to dead-flat, for the after-body; and, as many timbers as it will take there mark upon it. Those timbers of the square body, forward and abaft, that will not come upon the moulds of dead-flat, on account of their being so crooked at the heel, may be marked upon one mould to each body, proceeding as before, only making the mould sufficiently broad at the lower end to take the most crooked timbers thereon. The different methods of making moulds being already described, it only remains to make choice of that which is most convenient.

The Toptimber Moulds (Fig. 13.) may next be made; in order to which, let a mould fay to the line of dead-flat, and the inside to the scantling line, to extend in length from the top timber-heel to above five or six feet above the toptimber line; let there be marked on it the toptimber line and top side, the upper and lower heights of breadth, portsill line and level lines between, and likewise the toptimber heel, which is all that will be wanting for dead-flat. In the next place, make a slight mould to fay to the hollow of the top-side, in length from the head of the mould already made, to about nine inches below where the hollow breaks in with the upper-breadth sweep, but keeping its own fair curve; this mould is called the Top-timber Hollow. (Fig. 14.) By these two moulds all the top-timbers of the square-body may be moulded.

The top-timber mould, being the same with the upper part of the fourth futtock-mould, will therefore fay to all the square-timbers in the same manner; but, as the upper part of the top-timbers amidships (in some ships) tumble home much more than they do forward and aft, it consequently follows, that the mould at the upper part will be farther off from the line of the timbers, as it goes forward or aft. Place the lower part of the mould well with the after square-timber; and, as it lies, mark on the mould the heel, the lower and upper heights of breadth, portsill and level lines, top-timber line, and top of the side; then take the distance, on a square, of the mould, from the line of the timber at the top-timber line, and mark it down in figures at the top-timber line marked on the mould; then take the top-timber hollow mould, and move it up and down till it fays to the hollow of the line that the top-timber mould lies to, and mark the top-timber line upon it also, and likewise the name of the timber. The position that these two moulds lie in will then describe the proper shape of the moulding edge of the timber, and they must therefore be in that position when the top-timbers are moulded. In the same manner proceed with all the intermediate timbers, by which they may all be marked on the moulds, and likewise mark all the timbers, sirmarks, spilings, &c. on the other side of the moulds. Now provide another mould to dead-flat, similar to the former; and, acting as before, the timbers of the after-body may all be marked thereon. Thus may the top-timber moulds be provided for the whole of the square bodies; or they may be formed by the other methods, if preferred.

As the foregoing moulds differ in their *practical application*, it may be necessary here to describe that difference. The first in order are the floor moulds. Now, *to mould the midship floors* by the moulds (Fig. 4.) proceed as follows: Take the two floor moulds, and lay them on the timber, placing the end of one over the end of the other, and moving them till the middle lines of each are exactly well with each other, and the under part of both forms one strait line; they then may be confined together in that position by a nail or gimblet, just to hold them together for the present; then set off, from the middle line on the moulds, the half siding of the keel, at which place apply the rising-square, keeping the arm which is not marked well with the lower part of the moulds; then, to the side of the rising-square, apply the cutting-down batten; keeping the corresponding marks of the floor together. We shall now see whether the piece will make the floor, by moving the moulds downwards, (taking the greatest care not to alter their position), till the upper end of the cutting-down batten is well with the upper side of the piece: then see if there is wood sufficient for the cutting down and seating, and likewise sufficient wood at the outside of the moulds at both ends, for moulding according to the dimensions; if there be, the moulds may be rased by, upon the piece of timber, and, likewise, the sirmarks. Then, by taking the floor-hollow, and keeping that line on its lower end, marked for the side of the keel, well with its corresponding mark on the rising-square, and the other end well with the floor-mould, the true shape of the floor will be described from the head to the side of the keel; by which means the shape and size of the chocks required to complete the floor may be seen. Observe, as the cutting-down rises afore and abaft dead-flat, that there is wood sufficient left on the floor for that bevelling.

To *mould floors* by the frame mould made to the floors afore and abaft, as Fig. 5, the mould is likewise laid upon the piece, and the line for the intended floor is brought towards the outside of the piece: then see if there is cutting-down in the piece sufficient for bevelling, and substance below it for seating. When that is done, if there remains sufficient wood to shape the floor agreeably to its line on the mould, which is easily seen by marking spots on the piece, corresponding with the lines on the battens, and thence observing whether there is wood sufficient to mould the inside agreeably to the scantlings given. The above-mentioned spots may be made conspicuous on the piece, and the cutting-down also marked from the mould; then its corresponding first futtock-mould will finish the moulding-edge, or a pliable batten may be pinned to the spots, and the moulding edge found as low as the piece will admit (so that it is not within the given substance below the cutting-down); the batten being fair, rase by its edge; and rase up likewise the sirmarks; and, at those places, set off a square, from the outside already rased, the given scantlings, and pin the batten thereto, as also to the cutting-down, and rase by its edge; the inside of the floor will then be completed.

To *mould the lower futtocks*, by the moulds as Fig. 6. After the mould is laid upon the piece, and you are convinced that the upper part will mould, (and here we must have sufficient wood left for bevelling as it is standing from the moulding side,) we shall only have to take the floor-hollow of the timber we are going to mould; and, by keeping the floor-ribband diagonal mark upon it well with the floor-ribband diagonal marked upon the lower futtock-mould, and the heel in distance from the lower futtock-mould, whatever is marked thereon, the true shape of the lower futtock will thereby be described.

Those lower futtocks which are to be moulded from framed moulds, as Fig. 7, are moulded exactly similar as the floors of Fig. 5, last described, as, likewise, are the other futtocks, if upon framed moulds.

When the futtock-moulds are made with one edge to each timber, as those of the second futtock, Fig. 8, they are laid upon the piece, and kept well off to the outside edge in second futtocks; and, if the piece comes to the mould, see that you have wood left sufficient to answer the scantlings, the moulding-way, and wood left inside for the bevellings (as second futtocks are under bevellings from their moulding sides): if so, rase by the edge of the mould, and mark by your sirmarks, or bevelling places, and head and heel; then take off the mould, and set off, from the edge already rased, the moulding scantlings, square from the rase at their respective places; then see if the edge of the mould will not form the inside, by moving it up or down; if not, it must be finished with a pliable batten as before described.

Moulds made like those to the third futtocks, (Fig. 9.) are, with regard to the frame timbers, used exactly as those at Fig. 8, recollecting to have bevelling wood sufficient *without* the moulding-edge, as third futtocks are standing-bevellings from their moulding side; but, as these moulds were spiled to their adjoining filling-timbers, of course, when moulding a filling-timber, we have only to see that the piece answers to those spilings, and to proceed as before.

The *fourth futtock moulds*, as Fig. 12, are laid upon the piece, and should lie in an horizontal position (as indeed all moulds should to try the bevellings). Then see that the piece forms agreeably to the line on the mould of the timber about to be moulded, by fixing a gimblet down the holes, at the various sirmarks below the main or lower breadth; observing, at the same time, that the piece is strictly conformable to the head of the mould; when both are found to agree, and there be wood in the piece sufficient for the bevellings, rase by the side of the mould inside and out, as low as the lower breadth; below that may be completed by the head of the corresponding third futtock, keeping it well to the spots made by the gimblet at the heel, third futtock-ribband, &c. which must also be rased upon the piece; likewise the heights of breadth, portsill line, top-timber line, topside, &c. The inside towards the heel is finished by the scantlings given, and a batten as before described. But, when fourth futtock-moulds have spilings at their heads, owing to the difference in the tumbling home of the side, then, as the mould lies upon the piece, and the heel is found to answer, it must be seen that the upper part of the piece comes to the spiling marked upon the mould; then, towards the heel may be finished as before; but the upper part, above the upper breadth sweep, must be completed by the top-timber hollow. The top-timber line, marked thereon, must be placed to that given by the fourth futtock-mould, with its edge there fixed to the spiling, and its heel to the back of the upper breadth sweep: its edge may then be rased by, by which means the fourth futtock will be formed up to the head or top of the side, on the moulding edge; then set off the scantling from the fourth futtock-mould at the head, upper breadth sweep, and likewise between, and the top-timber hollow placed to those spots will form the inner edge of the said fourth futtocks, and so will the timber be completed.

Top-timbers are moulded so much like the upper part of the fourth futtocks, as to render a further description unnecessary.

The moulds for the square body being finished, proceed to make moulds for the stern and stern-post: The MOULD FOR THE STERN (Fig. 15.) is made to the lines representing the fore and after sides, or moulding-breadth, from the head to the heel; but in pieces, according to the number the stem is to be composed of; the rabbet is described on the mould, or represented by the batten that forms the aft side, being made parallel to the thickness of the bottom plank; but, if the rabbet comes in the middle, a batten of this description must be placed upon the mould, agreeably to the rabbet on the draught. Upon this mould must be marked the stations of the decks, and also the heights of the harpins, by an horizontal line across the mould, (some mark every two feet above the upper edge of the rabbet of the keel upon the mould). There must also be a perpendicular line, or, in other words, a square line to set the stern by, which may be the perpendicular of the lower deck.

The stern-post mould (Fig. 16.) may then be made to the lines representing the fore and after sides of the stern-post, and likewise to the head and heel, and a batten to the rabbet; then, across the mould, may be marked the height of the upper side of the wing-transom at the middle line; and, also, the heights of the harpins. Another mould must then be made for the bearding line on the post, (Fig. 17.) the aft side of which must be fayed to the bearding line from the upper side of the wing-transom down to where the bearding line intersects the fore side of the inner post, and the fore side to the fore side of the inner post, then, upon this mould must be marked the stations of the upper edges of all the transoms, marking their respective names thereon. By many this mould is not made, but the whole is marked upon the stern-post mould.

Another small mould may be made to the thwartship bearding of the stern-post (Fig. 18.) thus: Square down the intersection of each water-line with the fore side of the inner post in the sheer plan, (as shewn in Plate 2.) to the corresponding water lines in the half-breadth plan; then take the several half-breadths from the middle line in the half-breadth plan, and set them off from a straight line at their corresponding heights in the sheer-plan, and a curve drawn to pass through those spots will give the thwartship bearding of the post, at the fore side of the inner post, to which the mould is to be made: the same may be done, and a mould made, to the foreside of the main post.

§ 3. TO TAKE THE BEVELLINGS OF THE TIMBERS IN THE SQUARE-BODY.

The moulds for the timbers of the square-body being made, we shall, in the next place, shew in what manner their bevellings may be taken; for, until then, the timbers which have bevellings cannot be cut out. It was a custom with some to have only two bevelling-boards, one to each body, and so making them very long, in order that they might take all the bevellings. But this is a very unhandy way for large ships, where a great number of people are employed, andbeing very confused, occasions a great many mistakes. Others have a bevelling board to every ribband and head, which is altogether as unhandy as the former; for some, when they want the bevellings for one futtock, have to fly to six or seven boards before they can have them; besides, by sometimes taking a wrong board by mistake, the timber may be spoiled. The method that we recommend is, therefore, to have one board to hold the bevellings of all the first futtocks, and likewise one for the floors, each containing every square timber in the fore body, as the after-body might be marked upon the other side; then, to take the bevellings for a floor, or a futtock, it would only be to look for the floor or that futtock bevelling-board, and there the bevellings would all appear regularly one after the other at one view, for their respective timbers, and taken off with little trouble, and it would then be impossible to make a mistake, unless the name of one timber was mistaken for that of another.

Provide a bevelling board for the floors, (Plate I.) in breadth as much as the floors are sided; and, in length, sufficient to take all the floor bevellings thereon. The first bevelling to be taken is from the cutting down line, but the midship floor timbers we shall find to be square, which may be marked as such upon the board. Then apply the bevel to the next floor to the midship ones, keeping the stock well to the joint below the cutting down line, and the tongue well with the cutting down line, as at the filling between F and H, Plate I, and that gives the bevelling for the throat of that floor. Proceed in the same manner with every floor, till all those bevellings be taken and marked on the board; distinguishing them by writing their respective names upon every line. These bevellings will all be standing ones, both in the fore and after bodies, and are for the purpose of trimming the throats of the floors. In the next place, the bevellings for the outsides of the floors must be taken, which are always under bevellings in both bodies, in consequence of the floors being always placed on that side of the joint that the body declines from; these bevellings are, the lower diagonal, the second diagonal, or floor ribband, and the floor head. To take these bevellings from the body plan, proceed as follows: the bevelling board being parallel, set off the breadth of it square from the joint of each floor (observing, as before, that the floors in the fore body are before the joint and those in the after body abaft it). Upon each of the diagonals, in the half-breadth plan, the diagonal formed by the heads of the timbers being run in the half-breadth plan as far as the square bodies for that purpose; then take the distance of each spot set off, square from the middle line of the half-breadth plan, and set them off on their corresponding diagonals from the middle line in the body plan, making of spots; then fix one leg of a pair of compasses on those spots, alternately, and, with the other leg sweep the nearest distance to the line of its corresponding timber. That will determine what it is within a square in the breadth of the bevelling board, and, consequently, give the bevelling at each place; thus the bevellings may be taken for every diagonal, for every floor-timber, and be thence marked upon the board, as shewn in Plate I.

In the next place, provide bevelling boards, one for each futtock, (Plate II.) and one for the top timber, observing that the breadth of each board corresponds with the siding of its respective futtock and top timber; then, to take the bevellings for each, we must act as before explained for the floors; only observing which futtocks are standing bevellings and which are under; for futtocks that have standing bevellings, the breadth of the bevelling boards, or siding of the timber, must be set off in the fore body half breadth plan, upon each diagonal, abaft the joint of its respective timber; and, in the after body before the joint, and so contrarywise for those which are under.

Therefore observe, that floors are under bevellings, first or lower futtocks standing bevellings, second futtocks under, third futtocks standing, fourth futtocks under, and top timbers standing, bevellings. The bevellings of each may now be taken at every diagonal, for every timber, and marked on their respective boards, the fore body on one side, and the after body on the other.

The bevellings to be taken for each futtock and top timber are as follows: For the lower or first futtocks, lower diagonal, second diagonal or floor ribband, third diagonal or first futtock ribband, and first futtock head. For the second futtocks, floor head, which is second futtock heel, third diagonal or first futtock ribband, first futtock head, fourth diagonal or second futtock ribband, and second futtock head. For the third futtocks, first futtock head, which is the third futtock heel, fourth diagonal or second futtock ribband, second futtock head, fifth diagonal, or third futtock ribband, and third futtock head. For the fourth futtocks, second futtock head, which is fourth futtock heel, fifth diagonal, or third futtock ribband, third futtock head, main breadth, port sill line, top timber line, and level lines between, and top side. For top timbers, third futtock or top-timber heel, main breadth, port-sill line, top-timber line, level lines between, and top side. The bevellings for the main breadth, and all above, may be taken from the half-breadth plan, by fixing the stock of the bevel to the joint of the timber, and moving the tongue to the respective half-breadth lines, as at G, Plate I. Main breadth, for a top timber, and top timber half-breadth, for a fourth futtock; observing, that the breadth bevellings are standing for the top timbers, and under for the fourth futtocks.

A more expeditious method may be used in taking the bevellings of the timbers in the square body; for which purpose the diagonals at the heads need not be run in the half-breadth plan, nor any of the diagonals for the bevellings only. Take, with a rule, the leapings, or distances between every other timber, in the body plan, upon a square with each timber at the intersection, at the diagonal line with the intermediate timber (which is the timber the bevelling belongs to) halve that distance, and mark the half distance upon the rule, and continue so to do from the first timber that has any bevelling to the foremost square timber in the fore body, and the after square timber in the after body, on each diagonal line beginning with the lower diagonal. Strike two parallel lines on a board distant from each other the spacing of the timbers, or nail a batten, the thickness of the bevelling board, to each line. Then square a line over at the top, which always answers for dead-flat and for the timbers without any bevellings; then, from the square line at the top, set down on the right hand parallel line the divisions as taken on the rule; then, against this side or line, place one edge of the bevelling board, keeping nearly the upper part of the board well with the square line; then fit one edge of a straight batten well with the square line, and mark it across the board, and print towards the left side of the bevelling board ⊕, and the names of the timbers having no bevelling. Next, moving the board upwards about three quarters of an inch, and keeping its edge well with the line on the right hand, fix the batten well with the angle made by the square line on the left side, and the first division below the square on the right side, then mark that across the board, and its name also, as before. By moving the board upwards, three quarters of an inch as before, and keeping the edge of the batten well in the angle on the left side, and to the divisions on the right hand, as shewn in Plate 2. all the bevellings belonging to the floors, second futtocks, and fourth futtocks, may in succession be described, because they are all under bevellings; as, by this method, under bevellings only are taken; but, for the timbers on the other side of the joint, we have only to reverse those bevellings already taken, by which means the standing bevellings of the first futtocks, third futtocks, and top timbers, may be set off and marked as before, the bevelling boards being similar to those already described.

§ 4. THE NATURE AND USE OF THE CANT-TIMBERS, WITH THE METHOD OF LAYING THEM DOWN BY WATER-LINES.

Hitherto we have considered the timbers as having their planes perpendicular both to the sheer and half-breadth plans, and have, consequently, termed them *square timbers*. But cant-timbers have their planes inclined to the sheer (or *canted* as shipwrights term it) but perpendicular to the half-breadth plan. To illustrate this further, and so that the student may clearly understand the nature of the cant-timbers, we shall describe them in the following manner.

Observe in the half-breadth plan of Plate I. where the joint of cant-timber u intersects the middle line; at which place suppose it hung on a hinge, moving fore and aft, and also imagine the line drawn for the cant-timbers on the half-breadth plan to represent the upper edge of a large surface, the breadth of which is equal to the distance of the line of the same cant-timber, on the body plan, from the middle line; and, supposing the horizontal view of that surface to be represented by that one line. It immediately follows, that the surface must stand perpendicular to the upper edge of the keel, similar to a door swinging on its hinges; and, if we draw the proper shape of the cant-timber, according to the shape of the body, upon this surface, from the keel to the top of the side (not moving its position) and then cut it out, we shall have the true position of the cant-timber as in its place on the ship, which will stand in a perpendicular direction; we may also, (supposing it to be hung), swing it either forward or aft, and it will still maintain its perpendicularity with respect to the keel.

The canting of the timbers are of great utility, as they greatly contribute to the strength of the ship in the fore and aft parts, and likewise greatly assist the conversion of the timber. For, in the first place, by canting the timbers gradually from a thwartship line, we thereby bring each timber nearer to a square with the planks of the bottom, which is not only best for the security of the planks, but the timbers are also better able to bear that security. And, secondly, were all the timbers of the bow and buttock to be placed square, as those of the square body, though the scantlings of the square timbers on a square should be equal to the scantlings of the timbers if canted, yet the bevellings of the bow and buttock timbers would be so great that the consumption, in some places, in order to get the timbers clear of sap, would be greater by one half than that in the timbers when canted.

The cant-timbers may be taken from the sheer draught, and represented in the half-breadth plan, on the floor, (Plate 3) both for the fore and after bodies. Their room and space, on the main half-breadth line, may be governed by the square timbers, the sides of the ports being considered; but, at the heel, or middle line, of the half-breadth plan, they should be placed as near together as they conveniently can be, in order to make the bevellings of the timbers as square as possible.

THE METHOD OF LAYING OFF THE CANT-TIMBERS BY HORIZONTAL LINES, OR BY THE WATER LINES, IF HORIZONTAL.

This method, as it is the easiest, is best for the student to begin with. Having proved that the diagonal lines, represented in Plate I, will make a fair bow as run in the half-breadth plan, as they cannot be altered after the cant-timbers are run, proceed to lay down the joint of u, being one of the foremost cant-timbers; which, being the most canted, will be the more easily understood.

Take the intersections, on a thin edge batten, of each water line, in the direction of the line of cant-timber u from the middle line of the half-breadth plan, and set them off, upon their corresponding water lines, from the middle line in the body plan. Then, where the line of cant-timber u, in the half-breadth plan, intersects the main half-breadth, the top-timber half-breadth, port sill line, the horizontal lines between, and the top side, square up to their corresponding lines in the sheer-plan, marking the intersections thereon with a spot; at these places take their heights from the upper edge of the rabbet of the keel, and transfer those heights to the body plan, striking thereon horizontal lines, which will represent the heights of the main breadth, top breadth, &c. of cant-timber u. Then take, in the direction of the cant line u, on the half-breadth plan, the main breadth, top breadth, port sill line, top side, &c. from the middle line in the half-breadth plan, and set them off from the middle line in the body plan, on their corresponding heights just drawn.

Then may be drawn, across the body plan, horizontal lines between the main height of breadth and top timber line; thence run them in the half-breadth plan in the same manner as the water lines; next take them off from the half-breadth plan, in the direction of the cant line of timber u, and set them off on their corresponding horizontal lines in the body plan. *(This is omitted in the Plate, as the port-sill line will suffice).* The spots in the body plan, which are now set off, will give the exact shape of the cant-timber, but it yet remains to find the exact heeling or termination of the lower part.

Take, from the body plan, the distance of the bearding, or half siding, of the dead wood from the middle line, and set it off from the middle line in the half-breadth plan of the cant-timbers; striking a line, parallel to the middle line, which line will represent the bearding or half siding of the dead wood in the half-breadth plan; then, where the line of the cant-timber u intersects the bearding line, square it up to the bearding line in the sheer-plan; which height take off, and set up the middle line of the body plan, squaring it out towards the bearding line. Next take the distance from the middle line in the half-breadth plan, to where the cant-timber u intersects the bearding line, in the direction of the cant line, and set it off from the middle line in the body plan, on the line last squared out, which will give the spot where the heel of the cant-timber ends. Then pin a batten to those spots, and it will form the curve representing the shape of cant-timber u, in the body plan.

It would be unnecessary to describe here any other timber besides cant u, as the remaining cant timbers either belonging to the fore or after cant body may be described by proceeding in the same manner.

This method of laying down the cant-timbers is much the easiest; but, when adopted, the body ought to be laid down as fair as it can possibly be, and the water lines should be exactly conformable thereto; for, as the water lines cut the timbers in an oblique direction, the least variation would cause a very great error in the shape of the cant timbers, when drawn in the body plan. We would, therefore, not recommend this method for the mould loft, because, as the diagonal and horizontal ribbands must, of necessity, be run, it will be better to lay off from them, as the position of the diagonals are nearly square from the timbers, and will therefore be less liable to error; but the utility of understanding this method of laying off the cant-timbers, by water lines, will be sufficiently seen, in the following instance. When a draught is designed, from which we are going to build, we may examine the shift of the timbers, and may perceive some difficulty, with respect to the long timbers, that may make us apprehensive the timber will not prove sufficient to work so long as the shift designed, the square timbers being much more hollow than the cant; then, the water lines being generally drawn in the draught, and the ribband lines omitted, we may, from the water lines, lay off the cant-timbers in the body plan, and thence be capable of judging how the long timbers will agree with the conversion of the timber. Or, even supposing the ribband lines to be run in the draught, it would be by much the quickest way to make use of the water lines; and, in the hurry of business, when the artist is confident in the correctness of the body and water lines in laying off, this method is used.

§ 5. TO BEVEL THE CANT-TIMBERS BY WATER LINES.

The laying off of the cant-timbers and their bevellings by the water lines only, is not meant to be particularly recommended for the mould loft; therefore the bevelling of timber u, Plate I, will be sufficient to shew the nature of bevelling the cant-timbers by water lines.

Suppose it were required to bevel the timber that is before the joint, or moulding edge of u. Strike a line in the half-breadth plan, Plate I, at the foreside of and parallel to the joint of u, (the same distance from u, as the timber is intended to be sided) and draw a line, square from the cant line, at its intersection with the middle line in the half-breadth plan, to the line just struck for the siding of the timber; the intersection of the square line, or touch of it at the siding line, we may suppose to be the middle line in the body plan.

Then take the distance from the intersection of the square line to each water line along the cant line representing the siding or foremost edge of timber u, in the half-breadth plan, and set them off from the middle line in the body plan on each corresponding water line.

Square up, from the half-breadth plan, where the fore edge of timber u intersects the main breadth line up to the height of breadth line in the sheer-plan: take that height from the line A B, and set it up from the line A B in the body plan, striking there a horizontal line.

Then take the distance from the intersection of the square line in the half-breadth plan, as before, to the intersection of the fore edge of the timber with the half-breadth line, and set it off from the middle line in the body plan upon its height of breadth just levelled out.

Then observe where the fore edge of timber u, in the half-breadth plan, intersects the bearding line; and square it up to the bearding line in the sheer-plan. Take that height from the line A B, in the sheer-plan, and set it off from the line A B upon the bearding line in the body plan, striking there a horizontal line.

Take the distance from the intersection of the square line, as before, to the intersection of the fore edge of the timber at the bearding line in the half-breadth plan; and set it off from the middle line of the body plan on the line just levelled, for the height of the bearding line, which gives a spot for the heel.

Then pin a batten, and produce a fair curve through the spot on the main breadth line, and the spots on each water line to the spot at the heel of the timber. The curve will be the exact moulding of the fore side of the timber, which is the ticked line within cant-timber u, in the body plan of Plate I.

Observe, also, that so much as the ticked line is within the cant-timber u, in the body plan, so is the bevelling of timber u, (from the main breadth to the keel) within, or under, a square.

If it were required to bevel the timber that is at the aft-side of the joint of u, then, a square from the intersection of the joint with the middle line, in the half-breadth plan, will consequently come as much within the middle line, A B, as the intersection of the fore side came without, striking a line for the siding of the aft-side of the joint the same; which would be the exact point to form the after edge or bevellings of the timber that comes abaft the moulding edge. The operation being exactly the same as laying down the fore edge, it is needless to repeat it.

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§ 6. OF LAYING DOWN THE CANT-TIMBERS BY THE HORIZONTAL RIBBAND LINES.

IN this section we shall proceed to lay down the cant-timbers by the horizontal ribband lines, which is the method most in practice, and that which may always be depended upon.

The buttock, or aft part of the ship, and the bow, having been proved fair by the buttock lines in the sheer-plan, the timbers of the body plan and likewise the diagonal lines in the half-breadth plan, will be found to agree with each other, as in Plate 2. But, to avoid confusion, and to render it as clear as possible, as in Plate 3. strike a straight line A B, representing the upper edge of the rabbet of the keel, from which square up the joints of the square timbers of the fore and after body, the after perpendicular d c as far forward and aft as the cant-timbers extend in the sheer-plan. From Plate 2. likewise strike in the rabbet of the stern post and stem; the heights of the main breadth port-sill line, top timber line, top side, and the bearding line. In the half-breadth plan, Plate 3. describe the main half-breadth, top timber half-breadth, and port-sill line; and the round aft of the wing transom, and margin line, from Plate 2. Then, as in Plate 3. square up a perpendicular line to represent the middle line of the body plan, half siding of the stem, stern post, rabbet, and bearding-line; likewise the square timbers in the cant-bodies, diagonals, and round-up of the wing-transom and margin-line, all from Plate 2.

We may now proceed to lay off the horizontal ribband-lines, which may be done in the following manner: mark the distances taken square from the middle line in the after body-plan, Plate 3, upon a batten, to where the third futtock-ribband intersects each of the square timbers, as far forward as the after timber of the square body, which is 28. Then set them off from the middle line, on their corresponding timbers in the half-breadth plan, Plate 3; and, by drawing a curve through the spots so set off, the horizontal third futtock ribband-line will be represented in the half-breadth plan. The ending of it may be performed as the ending of a diagonal line, with only this difference, that, instead of taking the half-breadth of the post in the direction of the diagonal line, it must be here taken square from the middle line in the body-plan to where the line for the side of the post intersects the said diagonal or third futtock-ribband. Then, by proceeding in the same way, with the rest of the diagonal or ribband lines, the horizontal ribband lines may all be described.

The horizontal ribband lines being now laid off, strike in the cant-timbers, and proceed to lay them off; and, as the after timber and foremost timber have the greatest cant, they will shew the nature of laying down in the clearest manner. Therefore, mark the distance on a batten where the third futtock horizontal ribband line intersects the after cant-timber 38, square from the middle line in the half-breadth plan, and set it off square from the middle line in the body-plan on the third futtock ribband line, where it shall happen to intersect, at which place strike a horizontal line; then take the distance in the half-breadth plan, in the direction of the cant line, from where the after cant-timber 38 intersects the middle line, to where it intersects the third futtock horizontal-ribband; and set it off square from the middle line in the body-plan upon the horizontal line last struck, which will give the spot for the cant-timber at that diagonal. By proceeding thus with all the other horizontal ribbands, the spots for each will be given at their respective diagonal or ribband lines. The operation once understood, all the intersections of one timber on the half-breadth plan, both on the square and cant, may be taken off at once, only marking different spots on the batten to distinguish which was taken square from the middle line, and those taken on the cant line; by which means, by a few horizontal lines being struck across the body-plan, the batten may be fitted square from the middle line, and the spot taken square to intersect the diagonal, and the cant spot set off at once, the upper edge of the batten producing the horizontal required. In the same manner is laid off cant-timber w in the fore-body.

The spots for the main-breadth, port-sill, and top-breadths, and horizontal lines above the main-breadth, as, likewise, the spot for the heel, may be found as before described in Section 4. Then, by drawing a curve through all the spots, the true shape of the timber will be described in the body-plan; and, by following the same method, the rest of the timbers and fashion-pieces may be represented, as in Plate 3.

When the moulds are made and crossed, or marked, it must be observed that the stations of the heads and diagonals are where the lines levelled out intersect the lines of the cant-timbers. On the heels of the double-futtock and half-timber moulds nail on a batten to the stepping and side of the dead-wood, or rase it on the mould, by which the heel is cut off. To perform this, set off, on the half-breadth plan, the thickness of the stepping, or half-thickness of the keelson, from and parallel to the middle line; then, from the middle line, in the half-breadth plan, take the distance, in the direction of the cant line, to the line last struck, as at y in the fore-body, and set it off from the middle line in the body-plan upon the line levelled out for the heeling of the cant-timber; and, from that spot, square up a line to the upperside of the cutting-down, which will give a spot for the inside edge of the timber, and will represent the side of the dead-wood to which the batten is nailed, or rased on the mould with spilings.

§ 7. TO LAY DOWN AND TAKE THE BEVELLINGS OF THE CANT-TIMBERS BY THE HORIZONTAL RIBBANDS.

THE cant-timbers being laid down, we may proceed to take the bevellings of them.

A bevelling-board may be provided for every cant-timber, both in the fore and after bodies; the breadth may be as much as the siding of the third or fourth futtocks, and of a length sufficient to contain all the bevellings which are abaft the joint on one side, and those which are afore it on the other, or each side of one timber as at 38 and w, which will be as regular and complete a method as we can pursue. Then, to lay down the bevellings of any one timber, strike a line on each side of it on the half-breadth plan, of a parallel distance, equal to the breadth of the bevelling-boards as at 38 and w. The ticked line afore it will be for the purpose of laying down the bevellings of the timbers which come afore the joint, and that abaft for those which come abaft the joint; then, from where the joint of the cant-timbers intersects the middle line of the half-breadth plan, square a line which shall intersect the ticked lines drawn on each side, and we shall find that the intersection at the fore edge will come within the middle line of the half-breadth plan, and the after edge without it, as may be seen at timber 38, and contrarywise at w, Plate 3. Next take the distance from where the horizontal ribband lines intersect the line struck at the fore edge of the cant-timber w, square to the middle line, and set them off square from the middle line in the body-plan; and, where they shall happen to intersect their respective diagonals, strike a horizontal line at every spot across the diagonal ribband, because the distances taken off in the direction of the bevelling edges will sometimes be without and sometimes within the joint edge. Then take the distance to the same intersections again, but in the direction of the cant line, to where the square line intersects the fore edge of w, or that without the middle line, and set off those distances square from the middle line, in the body-plan, on their respective horizontal lines last struck. Then square up the intersection of the fore edge of w with the bearding line in the half-breadth plan, to the bearding line in the sheer-plan, and transfer that height to the bearding line in the body-plan, and level out a line. Now take the distance in the direction of the fore edge of w, from its intersection at the square line, to the bearding-line or half-breadth of the dead-wood in the half-breadth plan, and set it off from the middle line in the body plan on the line last levelled out, which gives a spot at the heel; and finishes the lower end. Where the ticked lines or fore edge of w, in the half-breadth plan, intersects the main breadth, square it up to its corresponding lines in the sheer plan, where there is only a spot made, then transfer this height from the sheer-plan to the body plan, and strike an horizontal line.

Take the distance from the intersection of the square line of the fore edge of w, in the direction of the ticked line to the main half-breadth, and set it off at its height, just struck from the middle line in the body plan; from which spot draw a curve through the spots on the level lines, and spot at the heel; and the shape of the line will be described, which will give the bevellings for the fore side of the cant timber w; as the ticked line in the body plan, (Plate 3.). Then proceed, in the same manner, with the ticked line abaft the joint of w, which will give the bevellings for the aft side of the timber; as the ticked line, likewise, at w, in the body plan, (Plate 3.). Then, at the places where the ticked lines come without the joint of the timber, or farthest from the middle line in the body plan, the bevelling is so much without a square; and, where they come within the joint, or nearer the middle line, so much within a square in the breadth of the bevelling board.

It is to be observed that the bevellings of 38 in the after body, and all the cant timbers in the fore and after bodies, are laid down exactly in the same manner.

To take the bevellings.—Begin with the fore side of the cant timber w; the heel bevelling must first be taken, which gives the direction to trim the heels of the futtocks the fore and aft way, or faying to the deadwood; therefore, the outside of the deadwood being parallel to the middle line, apply the stock of a bevel well with the joint of the cant timber w, in the half-breadth plan; and place the tongue well with the middle line; or, at the half-breadth of the deadwood, (as in Plate 3.) letting it teach forward, which will be an under bevelling, and may thence be marked on the board. The bevelling of the heel may next be taken, to trim it at the outside, where it fays to the bearding line. Thus, where the cant timber or joint of w intersects the bearding line in the half-breadth plan, square it up to the bearding line in the sheer plan; and, at that place, let the tongue of the bevel be placed to the bearding line teaching forward, and move the stock till it is perpendicular, which will give the bevelling that may then be marked on the board.

The bevelling at the heel, or stepping outside, is best obtained by trimming the heel parallel to the inside, where it fays to the side of the deadwood, to the thickness of the stepping. Then, to take the bevelling at the lower diagonal, fix one leg of a pair of compasses in the line of the cant timber w, in the body plan where the level line intersects, and opening out the other leg to the ticked line representing the fore edge of the timber w, sweeping it till you get the nearest distance, and that will shew how much the bevelling is within or without a square in the breadth of the bevelling board, and may then be marked thereon; then do the same with the other diagonal lines, and the bevellings at each may be taken, and also marked on the board.

To take the bevellings at the main and top-breadths, and level lines between them, apply the stock of the bevel to the joint of the cant timber w, in the half breadth plan, and place the tongue in the direction of the respective half-breadth lines, as at top-breadth, observing to let the tongue teach forward; the bevellings for this side of the timber will be found to be under bevellings, excepting, perhaps, two or three of the lower ones, which, on account of the leanness of this part of the bottom may be standing.

The bevelling edges may be run above the main breadth, in the same manner as the joint described in section 6, fitting to the intersection of the square line at the heel of the edge respectively; but this is seldom done, as the bevellings taken from the half-breadth plan are found to agree exactly.

The bevellings may now be taken for the aft side of the timber, which will be standing bevellings; but the operation is performed as the former, only observing, that the square line at the heel comes withinside the middle line of the half-breadth plan, and likewise when the bevel is applied to take the bevellings above the main breadth, the tongue of it must teach the contrary way from before; these bevellings may then be marked on the other or same side of the board, and the board for the timber will then be complete.

In like manner may the bevellings be taken for cant timber 38, and so on, for all the other cant timbers, both in the fore and after-bodies, which may then be marked on their respective boards.

The fashion-piece is laid down in the same manner as the rest of the cant-timbers; and bevelled in the same manner as timber 38, afore it, which may be seen and proved in Plate 3.

Some only take the under bevellings in both bodies, and reverse them for the timbers that have standing bevellings; this may be found to answer, except for the timbers quite forward and aft, and bearding bevellings.

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§ 8. OF THE UTILITY OF THE TRANSOMS, WITH THE MANNER OF LAYING THEM DOWN.
(See Plate 4.)

THE transoms compose the stern-frame, of which there are as many, in general, as the form of the body will admit, of a kindly growth. The uppermost of them is called the WING TRANSOM, (by some the main transom) and this is the foundation upon which the whole stern is built. The transoms below it are for the purpose of finishing the after part of the ship, termed the buttock, which must be formed as strong as possible; for, as every transom crosses the buttock, or aft part of the ship, and is bolted through the stern-post, they may be considered as so many breast-hooks athwart the bows; and, when the planks are wrought on the buttock, and the wing transom-knees, and sleepers, or diagonal knees are bolted, it is certainly as strong as the bows, or fore part of the ship's body, which is supported by the breast-hooks.

It will be necessary, before we proceed any farther, to shew the thwartship view of the cant fashion-pieces in the sheer plan, (Plate 2.) Therefore, square up the intersection of the fashion-pieces with the water-lines, in the half-breadth plan, to their corresponding water lines in the sheer plan; (likewise square up where they intersect the buttock lines and ribband lines also, when they are represented in the sheer-plan) square up the intersection of the fashion-pieces with the bearding line, in the half-breadth plan, to the bearding line in the sheer-plan. Likewise, from the half-breadth plan, square up the intersections of the cant fashion-pieces with the main half-breadth, top-breadth, and portsill, or horizontal lines between, to their corresponding lines in the sheer-plan; then, describing a line through all these spots, from the bearding line, to the plank sheer, will give the thwartship appearance, of the foremost fashion piece and the others separately. *(Up to the main breadth will suffice for this plate of the transoms.)* In the same manner the thwartship view, of all the cant-timbers, may be obtained.

Then, in the body plan of Plate 2. run the edges of the cant fashion pieces, taken square from the middle line in the half-breadth plan; and, on the cant in the same manner as the joint of timber u forward, described in Section 4. By these means the fairness of the body may be proved, by trying how the aft-side of the foremost fashion piece corresponds with that run by the horizontal ribband in Plate 3.

If, in the sheer-plan of Plate 2, was described the heights of all the other transoms from the sheer-draught, the wing transom being already there, also in the body plan. The transoms might be laid off from the buttock lines; but, if they are laid down in the half-breadth plan, then only half or one side can be represented; the best method therefore will be, to lay them down in some convenient place on the floor by themselves, whereby both sides may be represented, and there will not be then such confusion in the lines. To make this work still clearer, Plate 4. is provided for the transoms only.

Take from the body plan on Plate 2, the proof timbers and the five after square timbers, the square and cant fashion pieces, the upper side of the wing transom and margin line, the middle line, bearding line, half siding of the stern-post, buttock lines, and base line also. From the sheer-plan take off the stations of the proof timbers and the said square timbers, the thwartship view of the fashion pieces, upper edge of the wing transom, and margin line, the rabbet of the post, buttock lines, bearding line, and upper edge of the rabbet of the keel; and, from the half-breadth plan, the middle line, the half breadth line, wing transom line, buttock lines, and bearding line, cant-line of each fashion piece, and as many square timbers at least as come abaft the heels of the fashion pieces; and, from the sheer draught, Plate 1. the heights of all the transoms; let the whole be represented as in Plate 4. and, for the plan of the transoms, some clear place on the mould loft floor, in the same manner, as they are disposed of in the half-breadth plan, Fig. 3, Plate 4, by describing them on both sides of the middle line; this, for distinction, may be termed, *Plane of the Transoms.*

The shape of the wing transom is already described to which the mould is to be made; the filling transom is next, which lies between the wing and deck; and, as it lies horizontally, the description of it will suffice for all the other transoms that come under the deck, which also lie horizontally. Strike on each side of the middle line in the plane of the transoms, Fig. 3, Plate 4, (and as low as the deck transom the inner post is sided the same) the half thickness of the deadwood or bearding line, taking it from the body plan. Then strike a perpendicular line, in the sheer-plan, at the intersection of the upper edge of the wing transom, at the fore part of the rabbet, and it will then serve to lay off all the transoms by.

Now, from the perpendicular last-mentioned, called *Perpendicular of the Transoms,* take the distance in the sheer-plan to where the upper side of the filling transom intersects the fore-side of the rabbet of the post or bearding line, and set it off from the same line in the plan of the transoms at the middle line, squaring a line across to each bearding line, which line will represent the after part of the filling transom at the middle line. Observe, where the bearding line of the post, in the sheer-plan, comes before the fore side of the rabbet to take the aforesaid distance to the bearding line of the post, as that terminates the after part of all the transoms; then take the distances in the sheer-plan, from the perpendicular of the transoms, to where the line representing the upper side of the filling transom intersects the different buttock lines, and set them off from the same perpendicular in the plan of the transoms, on their corresponding buttock lines on each side of the middle line. Then take the distances in the body plan, from the middle line, to where the same line of the filling transoms intersects the square timbers, and set them off on both sides of the middle line on their corresponding timbers in the plan of the transoms; now, by drawing a curve to pass on each side of the middle line, from the aft-side of the transom, through the spots on the buttock lines and square timbers, the true shape of the filling transom will be described on the upper side: or the transom may be laid off on one side of the middle line only, and the mould made to that half-side, then canted over square from the middle line, and the opposite side marked in at once, being sure of having both sides alike. This filling transom, having been laid off horizontally, of course, when moulding the filling transom, the mould must lie in a horizontal position; but, having so little room between the wing and deck transoms, it is necessary to give the filling transom a round up between both. Those who would be more correct in laying off transoms that have a round upwards, may see the subject farther explained in Section 10, hereafter.

To lay down the deck transom, draw a straight line in the sheer-plan, at the under side of the deck, at the middle line, to take that part of the hang of the deck only, which is terminated between the rabbet of the stern post and the fashion piece. Then take the round of the deck at every buttock line, as under the body plan, and set them off below the straight line before mentioned, in the sheer-plan, square from the straight line, drawing parallel lines to intersect the corresponding buttock lines in the sheer draught, which gives the proper station of the moulding edge of the transom. Proceed, in the same manner, with the lower edge, by striking a line for the lower side of the transom at the middle line, parallel to the former; and set the rounding down upon every buttock line, which gives the lower side of the transoms on the buttock lines; and, in order to bevel the deck transom by the buttock lines, apply the stock of the bevel to the parallel lines, and the tongue to the buttock lines respectively, agreeably to the depth of the transom.

The upper and lower sides of the deck transom being obtained on the buttock lines, in the sheer-plan, you may transfer their heights from the sheer-plan to the body plan respectively, and curves passing through those heights will give the upper and lower sides of the deck transom in the body plan.

The lines before-mentioned, in the sheer-plan, drawn parallel to the sheer of the deck, at the intersection of the buttock lines and fashion piece, should be continued to the perpendicular of the transoms; then take the distances from that line in the direction of the parallel lines to the buttock lines and fashion piece, and set them off square from the said line in the plan of the transoms on their corresponding buttock lines and fashion piece. Next take the half-breadth from the body plan, at the intersection of the deck, at the side, with the square timbers and fashion piece, and set them off on their corresponding lines in the plan of the transoms; this gives the form of the deck transom at the moulding edge by drawing a curve to pass through the spots as before.

The transoms under the deck, all lying horizontally, may be laid down by taking the distances of the buttock lines and bearding line from the perpendicular of the transoms in the sheer-plan, on the upper edge of each transom, and setting them off on their corresponding buttock lines from the same perpendicular in the plan of the transoms; and, also, at the timbers from the middle line in the body plan; and set them off from the middle line on their corresponding timbers in the plan of the transoms, which will give the spots through which the curves are to pass to represent the moulding edges of all the transoms.

Spots should also be set off, in the plan of the transoms, to prove the intersection of the transoms with the side of the fashion piece, which is the end of each transom; the cant fashion pieces being laid down in the body plan, take the distance from the middle line to where the different transoms intersect the cant of the fashion piece, and set them off from the middle line in the plan of the transoms, on the cant of the fashion piece there, which spot will give the exact ending of the transoms at the sides of the fashion piece.

Cut off the ends of the wing, filling, and deck, transoms, at the joint of the fashion piece and transoms No. 1, 2, 3, and 4, under the deck, at the aft-side of the middle fashion piece, and at No. 5, 6, and 7, at the aft-side of the lower fashion piece, as is clearly shewn in the plan of the transoms, where the middle fashion piece is represented as stopt at the under side of the deck transom, and the after fashion piece at the under side of the transom No. 4.

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§ 9. OF TAKING THE BEVELLINGS OF THE TRANSOMS. *(See Plate 4.)*

The bevellings of the transoms are sometimes taken from the buttock lines, in the following manner: apply the stock of a bevel to the line for the upper side of the transoms in the sheer-plan, and the tongue to the buttock lines, as at the filling transom buttock line 5, Fig. 2, letting the tongue be well at the upper and lower sides of the transom, which will give the exact bevelling of the transom, at their corresponding buttock lines; then, when the transom moulds are made to their lines in the plan of the transoms, the buttock lines must be marked on the moulds in the direction laid down, which is parallel to the middle line.

When the bevellings are taken in this manner, they may be very exact, but it requires great care, in applying them on the transoms; for the stock of the bevel must be kept in the direction of the buttock line at the upper side, and the tongue must teach to the buttock line at the lower side, which should be marked there. When this trouble has been taken, the transoms may be trimmed to a nicety; but, by this method, the bevellings are confined to the buttock lines, by which means some of the lower transoms will not have above one or two bevellings upon them, which will not be sufficient to get the exact shape of the under side.

The best method to find the bevellings will, therefore, be to lay down the lowersides of all the transoms, in the plan of the transoms, which may be done in the manner in which the uppersides were laid down; then the distance between the upper and lower sides in the plan of the transoms, will shew how much the transoms are under from a square in the depth, or siding of them, which must be the breadth of the bevelling board.

The lowersides being laid down, we have an opportunity of placing as many bevelling spots on the lower transom as we please, marking the sirmarks on the moulds, without any confinement, which may be divided equally between the breech and the fashion-piece, as the lower transoms 4, 5, 6, and 7, Plate 4.; then fix one leg of a pair of compasses in each of the bevelling spots on the moulding edge, and sweep the other till it takes the nearest distance of the lower edge, which will shew how much the transom is under from a square at each bevelling spot, in the breadth of the bevelling board; in the same manner may the bevellings be taken for the rest of the transoms, except the wing, filling, and deck, transoms, which are best taken from the buttock lines (as before observed). The wing-transom must be trimmed from the upperside to the margin line by one bevelling right across, which bevelling is taken from the upperside and rabbet of the post. Thence to the lowerside the bevellings must be taken from the buttock lines, as before described.

The bevellings for the deck-transom may now be taken, by applying the stock of the bevel parallel to the hang of the deck, at the middle line, and the tongue to each buttock line, keeping the tongue well at the upper and lower side of the transom, and so must be applied on the transom, by placing the bevel at each corresponding buttock line, and keeping the stock out of winding with the upperside of the transom at the middle line.

The bevellings for the breech of the transoms must be taken from the uppersides of the transoms, and the bearding-line of the post in the sheer-plan. The ends of all the transoms, when moulded, are trimmed square from the upperside; but, in applying the square to the ends of the wing-transom, deck-transom, and any which round up, the stock of it must be lifted till it lies in a horizontal position, and should be looked out of winding with a batten at the middle line; then, to find the bevellings for the ends of the transoms, when cut off, apply the stock of a bevel to the uppersides of the transoms in the body-plan, and the tongue to the line of the cant fashion-piece, which will give the bevelling required; but, to take the bevelling for the end of the wing-transom, we must take the distance square from the middle line in the plan of the transoms, to where the end of the wing-transom intersects the fashion-piece, and set it off square from the middle line in the body-plan, on the upper side of the wing-transom, and level it out till it intersects the cant fashion-piece as before. The bevelling for the end of the deck-transom, or any transom rounding upwards, may be taken from a line levelled out in the same manner; but it must be observed that, in applying the bevel on the wing and deck transoms, to lift it up as much as the transoms round down at the ends, and look it out of winding with a batten at the middle line.

When the lowersides of the transoms are laid down, it gives little trouble to make a narrow mould, to countermould the undersides of all the transoms, by making it only to one side of the transoms, and then cant it over, to mould the opposite side. Then, when the breech of the transom is trimmed to the bearding-line, set off the distance from the middle line each way, as far as the bearding-line is from the middle line in the plan of the transoms, or to which the transom mould is made. Then trim the end of the transom square, and set off the bevelling for the end of the transoms. Cant over the transom, and, with the mould made for the underside, you may have your transom countermoulded, without the assistance of any other bevellings; or they may be set off, to see if they agree with the mould; which, if they do, the work will certainly be correct.

Where the transoms that lie horizontally, in the body-plan, intersect the cant fashion-pieces, are the proper stations to be crossed on the fashion-piece mould. And where the line (beforementioned) levelled out, intersects the fashion-piece, is the proper station of the wing-transom on the fashion-piece mould, for the moulding-edge; but not for the direction in which the wing-transom strikes the fashion-piece, because of the round of the transom, as will be farther explained in the next section.

§ 10. TO LAY OFF THE TRANSOMS WHEN CANTED. *(See Plate 4, Fig. 4, 5, and 6.).*

The utility of canting the transoms is easily proved by the following good properties: it greatly assists the conversion of timber, and the transoms are situated better for receiving the fastening of the bottom plank and the bolts square to the stern-post. When the transoms have very great bevellings, it is difficult, at the upper edge, to get sufficient fastening for the planks, which sufficiently points out the advantage of canting them.

The same lines will be required from Plate 2, as before, in laying off the transoms when horizontal, as seen by inspection of the Plate, Fig. 4 and 5. The transoms below the deck only will here be canted, as shewn on the plate.

Now proceed to exhibit the horizontal view of the moulding edges of all the transoms in the body-plan in the following manner: The wing-transom and the filling, lying horizontally, form a segment of a circle in the body-plan, agreeably to the given round-up, which is the proper curve that the round-up mould is made to for moulding the transoms. The next transom is the deck-transom, which, being confined to the hang of the deck, and the round of the beam, is the more difficult; and, if executed in a proper manner, ought to undergo the following operation.

In the sheer-plan is drawn the sheer or hang of the underside of the lower deck, at the middle line, which is supposed to represent the upperside of the deck-transom, at the middle line. Take the heights of this line at every square timber in the sheer-plan, and set them up on their corresponding timbers in the body-plan; and, also, where the said line intersects the buttock lines in the sheer-plan, take off the heights and transfer them on their corresponding buttock lines in the body-plan; then, through those spots, form a curve, which will shew the upperside of the deck-transom, supposing it had no round down at the side. Describe a segment of a circle to the round of the deck under the base line in the body-plan; and, where the line in the body-plan, representing the upperside of the transom at the middle line, intersects the square timbers, square down spots to the round-up of the deck under the body-plan; then take the distance from the said spots square up to the base line, (which is the round of the deck at each timber,) and set them down below the hang of the deck in the body-plan where it intersects the corresponding timbers in the direction of the line squared down, and direct those spots towards the middle line parallel to the round of the deck, under the base line, till they intersect the square timbers. Where the last spots intersect the square timbers a curve must pass, which will shew the deck, supposing it continued to the outside of the timbers, which is required, in order to find the exact form of the moulding edge of the deck-transom. Continue the buttock lines in the body-plan to the round of the deck under the body-plan; then take the round of the deck at each buttock line, and set it down below the deck at the middle line in the sheer-plan; transfer the heights of these spots to the buttock lines in the body-plan; then, through these spots on the buttock lines and those on the timbers, describe the curve in the body-plan which is the deck-line at the side, if continued to the outside of the timbers.

To find the deck at the side, in the sheer-plan, take the heights at every square timber in the body-plan, where they intersect the deck at the side; and transfer them to their corresponding timbers in the sheer-plan. These spots, with those before made on the buttock lines, give the deck at the side in the sheer-plan; which is the horizontal view of the moulding edge of the deck-transom. To find the lowerside of the deck-transom in the sheer-plan, and likewise in the body-plan, proceed as for the upperside.

If you intend to be very correct, the ribband-lines may be run (which will be a proof to the rest of the work, in laying down the transoms); but, if the body be laid down, and made very true by the square timbers, water lines, diagonal lines, and buttock lines, you may then proceed to lay down the transoms by the buttock lines only.

To find the horizontal view of the cant transoms under the deck in the body-plan, observe where the upper and lower sides of the transoms in the sheer-plan intersect the buttock lines, square timbers, and fashion-pieces; transfer those heights to the body-plan on the corresponding lines which give the horizontal dispositions of the transoms in the body-plan. The transoms may now be laid down in the plan of the transoms, Fig. 6. Continue the uppersides of all the transoms in the sheer-plan to the perpendicular at the aftside of the wing-transom, where they are numbered. Take the distance from the said line in the sheer-plan to the bearding line at the half-breadth of the stern-post, in the direction of all the transoms, and set them off square from the same line in the plan of the transoms. Then set off the half-breadth of the stern-post at each transom taken from the body-plan, and draw the side of the stern-post in the plan of the transoms. This gives the ending of all the transoms at the side of the stern-post, and at the bearding line laid down at the half-breadth of the stern-post. Take the distances square from the perpendicular of the transoms in the sheer-plan (because the filling transom lies horizontal) to the intersection of the filling transom with the buttock lines and fashion-piece; and set them off square from the same line in the plan of the transoms, on their corresponding buttock lines and fashion-pieces; and, where the filling transom in the body-plan intersects the square timbers and fashion-piece, take the distance thence to the middle line, and set them off on their corresponding square timbers and fashion-piece, in the plan of the transoms, square from the middle line to intersect the fashion-piece; a curve described through these spots gives the form of the filling-transom.

The deck-transom requires the distances to be taken from the perpendicular of the transoms, in the sheer-plan, to its intersection with the buttock lines and fashion-piece at the side, parallel with the hang of the deck; set them off square from the same line on their corresponding buttock lines and fashion-piece in the plan of the transoms. Then take the half-breadth from the body-plan, at the intersection of the deck at the side, with the square timbers and fashion-piece, and set them off on their corresponding lines in the plan of the transoms. This gives the form of the deck-transom, as it is usually laid down: but, since the deck-transom lies to the sheer of the deck, and to the round of the beam, it may be laid down more exactly; as the alteration, however little it may be, depends on the sheer or hang of the deck and round of the beam, more or less: therefore, for farther proof, take the distance from the perpendicular of the transom, in the sheer-plan, to the square timbers in the direction of the sheer of the deck, and set it off square from the corresponding line in the plan of the transoms, which will shew how much the timbers gain forward in that direction, and call them *Sheer-timbers.* Now place a batten on the round of the deck, under the body-plan, marking the middle line and the timbers, as squared down, and set them off on their corresponding sheer timbers in the plan of the transoms. This would give the exact spots on the sheer timbers, if the deck was required to hang and round to extremes, in the same manner as by placing a batten to the round of the wing and filling transoms in the body-plan, and marking the square timbers and buttock lines on the batten. Then let the batten lie straight, and it will be the exact half-breadth at every square timber, buttock line, and fashion-piece, and will give the exact length of the wing-transom.

To lay down the transoms under the deck, take the distances from the perpendicular of the transoms, in the sheer-plan, to the buttock lines in the direction of the transoms, and set them off from the same line in the plan of the transoms on their corresponding buttock lines. Take the half-breadths in the body-plan square from the middle line to the intersections of the transoms, No. 1, 2, 3, 4, 5, and 6, with the square fashion-pieces, and set them off square from the middle line in the plan of the transoms, to intersect the said fashion-pieces, drawing a line parallel to the middle line, as may be seen in the plan of the transoms, Fig. 6. Then take the distance from the perpendicular of the transom, in the sheer-plan, in the direction of the 6th transom to the fashion-piece, and set it off square from the corresponding line in the plan of the transoms, on the line last made at the intersection of the fashion-piece; which spot may be proved again by striking a line at its intersection parallel to the after fashion-piece; then, from the middle line in the body-plan, take the distance in the direction of the upperside of transom 6, to where it intersects the after cant fashion-piece, and set it off from the middle line in the plan of the transoms, in the direction of the line last struck, and it gives a spot corresponding with the former. Take the distance from the perpendicular of the transoms, in the sheer-plan, to the square timbers, 33, 34, 35, 36, 37, and 38, and proof timbers in the direction of the line of the transom, and set them off from the same line in the plan of the transoms; and, as much as they come before the former timbers, strike lines parallel thereto: then take the half-breadths, square from the middle line in the body-plan, to where the transoms intersect the square timbers, and set them off from the middle line in the plan of the transoms on the timbers last struck. In the same manner proceed to find all the spots for the square timbers, in order to prove the buttock lines. A batten pinned to those spots will give the exact form of all the transoms below the deck, and the station of the fashion-piece on the transom, with the length of the transom on the moulding edge.

To find the direction of the end of the transom, to fay against the side of the fashion-piece, observe in the plan of the transoms, Fig. 6, where the fashion-pieces intersect the middle line, and square them up in the sheer-plan at the same distance from the perpendicular as you see ticked, calling them the fashion-pieces at the middle line in the sheer-plan. Take the distance from the perpendicular in the sheer-plan to the middle line of the after fashion-piece in the direction of the transom, No. 6, and set it off from the same line in the plan of the transoms on the middle line, and draw the ticked line from the spot on the middle line to the spot on the transom, No. 6. This will give the direction to cut off the end of the transom, in order to fay against the side of the fashion-piece.

§ 11. TO BEVEL THE TRANSOMS WHEN CANTED.

THOSE transoms which are not sided straight, as the wing, filling, and deck, transoms, are generally bevelled by the buttock lines, as before observed: but rather than trust to the bevellings only, (it being rather difficult to apply them so truly as they should be,) lay down the undersides of all the transoms, and make a narrow mould thereto. This will correct the bevellings, and make quicker dispatch in trimming the transoms. Then you need only (for proof sake excepted) take the bevelling at the bearding line and the bevelling at the end; for the counter-mould will give the rest. But, observe to be careful in the bevelling at the end of the transoms; for instance, the ends of the wing and filling transoms, as they lie horizontal, are to be cut off square; but keep the square as much above the end of the wing and filling transoms as they round in their length, and let the square look out of winding with the middle of the transom. Also the bevel (when applied on the end after it is cut off in order to bevel the end for counter-moulding) must be kept as much above the end of the transoms, and kept out of winding with the middle of the transom, as before observed in Section 9.

As the bevelling for the end of the deck-transom is taken against the cant fashion-piece, by a horizontal line in the body-plan, see how much the transom at the middle line in the sheer-plan is below a horizontal, and set that spiling upon the mould or bevelling board. Then place a batten at the middle line on the transom, and lift the foremost end to the spiling, so that the batten becomes horizontal, supposing the transom were in its place: then proceed with the square and the bevel for the end of the transom, in the same manner as for the wing and filling, looking out of winding with the batten at the middle line.

To bevel the transoms which are canted, in the sheer-plan, you must proceed in the same manner as in bevelling the cant timbers, by striking a parallel line to the moulding edge. Therefore, lay down the bevellings of the 6th transom, by squaring a line from its upperside where it intersects the perpendicular (by which all the transoms have been laid off) in the sheer-plan; and, where the squared line intersects the lower side of the transom, take the distance to the bearding line, and all the buttock lines in the direction of the line for the lower edge of the transom, and set them off square from the perpendicular line in the plan of the transoms on their corresponding lines. When the bearding line in the sheer-plan proves to be square from the cant of the transom, as at No. 6, or lower transom, then the bearding for the moulding edge, and likewise for the bevelling, will come together in the plan of the transoms. This proves that the method of bevelling is correct.

Where the lowerside of the 6th transom intersects at the square line in the sheer-plan, take the distance thence to the timbers 38, 37, 36, 35, and 34, and set them off and parallel to the perpendicular line in the plan of the transoms. Then take the distance square from the middle line in the body-plan to the intersections of the lower edge of the 6th transom with the square timbers and fashion-piece, and set them off square from the middle line in the plan of the transoms on their corresponding timbers last struck. Through these spots and those on the buttock lines, pin a batten, which will form the ticked line, and shew how much the transom is under from a square, according to the depth of the transom. Take the distance from the squared line at the lower edge of the 6th transom in the sheer-plan, to the after fashion-piece at the middle line, and set it off from the perpendicular line on the middle line in the plan of the transoms, and draw the ticked line thence to the spot on the fashion-piece, obtained in the same manner as the spot was on the upper edge, which will be a line parallel to the ticked line before described, to cut off the end of the transom; and the distance between the ticked lines shews how much the end of the transom is under from a square, according to the depth of the transom.

The ticked line in the plan of the transoms, which shews the bevellings, is the line to make the counter-mould to, in order to mould the underside of the transom; and, by cutting off one end of the mould to the thwartship line for the breech of the transom, and cutting off the other to the ticked line for the end of the transom, when the mould is applied to the underside of the transom, you may easily perceive if the work be true.

To find the proper bevelling to be applied on the end of the transom, after the end is cut off, and in order to counter-mould the transom, proceed thus: Where the upper and lower sides of the lower transom intersect the after square fashion-piece in the body-plan, level them out to intersect the cant fashion-piece. Where the upperside of the lower transom intersects the after fashion-piece, at the middle line in the sheer-plan, transfer that height, as is ticked in Plate 4., to the middle line in the body-plan, and thence draw a straight line to the upperside of the lower transom on the cant fashion-piece; to which line fix the stock of the bevel, and the tongue to the cant fashion-piece, as low down as the spot for the lowerside of the transom. This is the exact bevelling to be applied on the end of the transom, after the end is cut off, in order to counter-mould the transom. The straight line to which the stock of the bevel is placed, is the direction of the transom to be crossed on the fashion-piece mould. The bevel which is drawn in the body-plan, shewing the bevelling of the end of the lower transom, sufficiently proves the utility of canting the transoms; for, by having so little bevelling, it greatly assists the conversion of timber, as well as that it must certainly be better for the security of the plank of the bottom by its coming nearer to a square with the buttock.

§ 12. OF LAYING OFF THE SQUARE TUCK. *(Plate 5.)*.

WE have explained the utility of the transoms in composing the stern-frame, by which method most ships are inclosed abaft. But yachts and cutter-built vessels are, owing to their cleanness of shape, inclosed abaft by a square tuck, by which room is gained; and, when properly put together, this mode of construction is, perhaps, stronger than transoms would be in vessels of this description.

It has been generally supposed that the laying off of a square tuck is one of the most difficult points to be performed on the floor; but this is merely a chimerical idea, which has arisen in consequence of square tucks being so very seldom in use, that the generality of artists scarcely ever see the operation performed, and the description of it in books written upon this subject, has generally been so confused and imperfect as to afford the artist no useful knowledge; but, on the contrary, has led him in obscurity from one part to another, until he has unsuccessfully given up the whole.

In order to obviate such disadvantages, we shall proceed to explain, in as clear a manner as possible, the nature of a square tuck, both in a flat and round state, with the most approved methods of laying off and bevelling of the same, whereby the artist will be led progressively on, from the easiest to the most difficult parts of the operation, and by that means be enabled to improve himself by having a just explanation of the whole conveyed in a clear and proper manner.

We shall first propose a square tuck, such as that of the 80 gun ship's long boat, Plate 29, the sides of which are to be out of winding, or in the same direction as the rabbet of the post; in consequence of which the wing transom must be straight athwartships, and the whole will be one flat surface; it will be exactly similar to the section of a ship cut athwartships, but not in a perpendicular direction, which is the only difference between it and the square timbers; and, as the section is supposed to be agreeable to the rake of the stern, it consequently follows, that the laying it off must differ from the square timbers in the operation.

The horizontal view of the tuck must first be represented in the body plan, Fig. 1, Plate 5, in order to which proceed in the following manner: strike a horizontal line in the sheer-plan, at the height of the wing transom at the side, and likewise as many horizontal lines below that as may be thought sufficient; and, where they intersect the aft-part of the rabbet of the post, square them down to the half-breadth plan; then transfer their heights to the body plan, and where they intersect the square timbers in a horizontal direction, take them off and run them in the half-breadth plan, where the horizontal lines in the half-breadth plan intersect the lines squared down from the sheer-plan; take their distances from the middle line, and set them off from the middle line on their corresponding horizontal lines in the body plan; and, by drawing a curve through those spots, the horizontal view of the tuck will be represented in the body plan, as high as the wing transom at the side. But, as the head of the fashion piece is required to run up sufficiently to take a bolt or two through the heel of the side counter timber, proceed in the same manner to run a horizontal line or two above that at the side of the wing transom; say, one at the upper side of the wing transom at the middle line; then run the main half-breadth line in the half-breadth plan; and then, where the last horizontal line and main height of breadth intersect the aft-side of the rabbet in the sheer-plan, square them down to the half-breadth plan, and take their distances from the middle line of the half-breadth plan to where they intersect their half-breadth line, and set them off from the middle line on their corresponding horizontal lines in the body plan: next, by continuing the curve upwards through these spots, the horizontal view of the tuck will be continued up to the height of breadth.

Now, where the horizontal view of the tuck in the body-plan intersects the bearding-line, take the height, and transfer it to the sheer-plan, drawing a horizontal line, which will represent the seating of the tuck; then take the distance from the seating of the tuck in the sheer-plan on the rake, (in the direction of the rabbet of the post,) to the respective horizontal lines and height of breadth, and set them up the middle line, from the horizontal line at the seating of the tuck in the body-plan; striking a new horizontal line at every height, as shewn by the fine ticked lines; then, where the horizontal view of the tuck intersects the horizontal lines first drawn, square it up (from the base or any horizontal line) to their corresponding new horizontal lines; which will give the spots through which the curve is to pass that will represent the proper shape of the tuck, agreeably to the rake; and the line to which the fashion-piece mould must be made.

In the next place, the bevellings for the fashion-piece may be taken by proceeding as follows: The aft side of the rabbet of the post, in the sheer-plan, represents the aft side of the fashion-piece of the tuck; therefore, take the siding of the fashion-piece, and set it off afore the rabbit, and square thereto; then, by drawing a parallel line to the aft side, the fore side of the tuck will also be represented; next, from the seating of the tuck on the aft side, square a line from the rabbet to the fore side, from which intersection take the heights of the horizontal lines up the fore side, and set them up on the middle line from the horizontal line at the seating of the tuck in the body-plan, drawing of new horizontal lines for the fore side of the fashion-piece, as shewn by the long ticked lines; then, where the fore side of the fashion-piece in the sheer-plan intersects the horizontal lines and height of breadth; square it down to their corresponding horizontal lines and main half-breadth in the half-breadth plan, at which intersections take the distance square to the middle line, and set it off from the middle line on their corresponding horizontal lines, for the fore side of the fashion-piece in the body-plan: continue the fore side of the fashion-piece down to the bearding-line, as you see ticked in the sheer-plan; then take the distance from the intersection of the squared line at the seating down the fore side of the fashion-piece to horizontal line 1, and where it intersects the bearding line, and set it off in the body plan below the horizontal line at the seating of the tuck down the bearding-line; strike a new horizontal line for No. 1, and proceed as before directed to obtain the half-breadth spot on the half-breadth and body plan; then, through all these spots, draw a curve which shall cut its intersection with the bearding-line, and the fore side or bevelling edge of the fashion-piece will be represented.

The aft side and fore side of the fashion-piece appear now in their proper shape in the body-plan, and of the same form as the fashion-piece when trimmed and laid flat with the aft side upwards, as then both edges will be seen, in consequence of its being a standing bevelling: therefore, the distance from the line representing the aft side to the line of the foreside taken on a square, will shew how much the bevellings are standing, or without a square, in the breadth of the bevelling board, which must be equal to the siding of the fashion-piece; or the bevellings may be set off on the mould where taken, as shewn in the plate.

Then, when the mould is made to the line of the aft side, the heel of it must be cut off well with the line for the seating of the tuck, and likewise well with the middle line; as the two fashion-pieces, when in their places, must meet at the middle line, in order to bolt and dovetail into the stern-post. Mark also on the mould the bearding or side of the inner-post.

The bevellings may be taken at the different sirmarks or ribbands, which sirmarks should be marked on the mould. But, in order to get the true stations of the ribbands, observe where the diagonal lines intersect the horizontal view of the tuck in the body-plan, and square them up (from the base line) to the line for the aft side of the fashion-piece to which the mould is made; this will give their proper stations or uppersides, and may thence be marked on the mould. The bevel in the plate is placed at a horizontal line to prevent confusion.

Run in diagonal 7, although the ending of it only differs from those before, and need only be described. Take the height square from the base line, in the body-plan, to the intersection of the seventh diagonal with the horizontal view of the tuck, and set it up, in the sheer-plan, at the aft side of the fashion-piece; and, from its intersection there, square it down to the half breadth plan; then take the distance in the body-plan from the middle line to the horizontal view of the tuck in its diagonal direction, and set it off from the middle line, in the half-breadth plan, on the line squared down, which gives its ending at the fashion-piece. In the same manner take the height where it intersects the upper side of the wing transom in the body-plan, and set it up in the sheer-plan; and, where it intersects the aft side of the fashion-piece, square it down to the half-breadth plan; then take the distance from the middle line in the body-plan as before, to the upper side of the wing transom, and set it off from the middle line in the half-breadth plan on the line last squared down; then, drawing a line through those spots as the ticked line in the half-breadth plan, Fig. 1, you will have the true ending of diagonal 7, or any diagonal crossing the wing transom and fashion-piece.

The transoms of boats are laid down similar to the square tuck, but composed of only one piece athwartships, and their upper side bounded by the upper side of the sheer. See *Long Boat*, *Plate* 29.

We have now laid down and described the square tuck, as supposing it to be a flat surface, with no round aft, in order that the artist may see the nature of it in that form, before he attempts to lay it down in a more difficult one; and, as supposing it clearly to be understood. We shall, in the next place, proceed to lay down a square tuck, the outside of which is to round forward, and that the laying down of it may be clearly understood, we shall first give a description of it in its finished state.

Suppose a flat surface, composed of thin deal or paste-board (in length from the wing transom or height of breadth to the keel, and in breadth equal to one side of the transom) was placed with one edge to the rabbet of the post, and the other edge bent round in a curve as much as the outside of the tuck is intended to round forward, in which position suppose it to be confined;

then, from the upper edge at the outside, set down the round down of the wing transom, from which place to the upper edge at the middle line, draw a curve, and cut it out; the upper part will then represent the upper edge of the wing transom; now draw the shape of the outside of the tuck down to the post, and cut that also; the true shape of the tuck is now shewn as it is to be trimmed, and as it will appear when in its finished state: then take it from its position and lay it flat, letting the round be unconfined; and it will then appear as it is required to be laid off in the body plan; in order to make the mould therefrom.

Therefore proceed, in the first place, to represent the horizontal view in the body plan as follows: strike a horizontal line in the sheer-plan, at the height of the wing transom at the side, and likewise several other horizontal lines at convenient distances below that, and one or two above, and where each horizontal line and height of breadth intersects the aft-part of the rabbet of the post, square them down to the middle line of the half-breadth plan, making of spots; then, upon the horizontal line at the height of the wing transom, at the side, set off from the aft-side of the rabbet of the post, the round forward of the wing transom, in the sheer-plan, and square it thence down to the half-breadth plan, upon which set off the half-breadth of the wing transom, and thence sweep a curve to the spot for the said horizontal line at the middle line of the half-breadth plan (the centre being in the last-mentioned line,) which will represent the aft-side of the wing transom at the height of the horizontal line at the side; now, from the other spots, squared down on the middle line of the half-breadth plan, sweep curves also, exactly similar and parallel to the curve of the wing transom. The heights of the horizontal lines may now be transferred from the sheer-plan to the body plan, and their half-breadths thence taken off and run in the half-breadth plan; as done in the foregoing operation, Fig. 1. Next take the distance square from the middle line in the half-breadth plan, Fig. 2, to where the horizontal lines intersect their respective curves for the aft-side of the tuck, and set them off from the middle line on their corresponding horizontal lines in the body plan; a curve drawn through those spots will shew the horizontal view of the tuck in the body plan; also, where the horizontal lines in the half-breadth plan intersect their respective curves, square them up to their corresponding horizontal lines in the sheer-plan; and, by drawing a curve to pass through the different spots, the thwartship view of the fashion-piece will be represented in the sheer-plan.

The thwartship view of the aft-side of the fashion-piece being shewn in the sheer-plan, we may perceive that it leaves the rabbet of the stern-post at the head, in order to be conformable to the wing transom at the side; yet we must have a line drawn square from the rabbet of the stern post, to lay down the tuck on the flat, the same as before, which may also be at the seating of the tuck.

Take, therefore, the nearest distances from the square line at the seating in the sheer-plan, to where each horizontal line and height of breadth intersect the thwartship view of the aft-side of the fashion-piece, and set them up from the said line in the body plan up the middle line, drawing horizontal lines at every height; then take the distance from where the horizontal lines in the half-breadth plan intersect their respective curves to the middle line in the direction of the said curves, and set them off from the middle line on their corresponding horizontal lines last drawn; then, a curve passing through these last spots, will give the form of the aft-side of the fashion-piece, that will agree with the other timbers when in their places, and to which line the fashion-piece mould must be made.

The line in the half-breadth plan, Fig. 2, or the aft-side of the wing transom, is not the line to make the wing transom mould to: therefore, where the curve of the wing transom intersects the horizontal line at the side, in the half-breadth plan, square out a line, as at a; then take the distance from the middle line of the body plan to where the horizontal line of the tuck intersects the horizontal line of the wing transom at the side in the direction of the round up of the transom, and set it off square from the middle line of the half-breadth plan on the line last squared out, which will give a spot for the end of the transom; then, where the upper side of the wing transom at the middle in the sheer-plan, intersects the aft-part of the rabbet of the post, square it down to the half-breadth of the post in the half-breadth plan, from which sweep a curve to the spot before made for the end of the transom and the upper side of the wing transom will be represented, to which line the mould must be made. The bevelling of the wing transom will be the same right athwartships, which bevelling is the rake of the rabbet of the post.

The aft-side of the fashion piece not being straight, it would be more troublesome and less useful to run lines to trim it by bevellings; therefore the best way will be to make a mould to the fore-side.

Proceed, therefore, to lay down the fore-side of the fashion-piece. Whatever it is to be sided, set off square from the rabbet of the post, in the sheer-plan, and see what it will be in the direction of the horizontal lines, which must be set off from the thwartship view of the aft-side on the horizontal lines, by which the fore-side may be represented in the sheer-plan; take the nearest distance from the square line for the seating, in the sheer-plan, to where the horizontal lines cross the foreside of the fashion-piece, and set them up the middle line in the body plan, from the horizontal line at the seating of the tuck, drawing horizontal lines: then, where the foresides of the fashion-piece crosses the horizontal lines in the sheer-plan, square it down to their corresponding horizontal lines in the half-breadth plan, from which take the distances to the middle line in the direction of the curves, ticked for distinction in the plate, and set them off from the middle line on their corresponding horizontal lines in the body plan. Continue the foreside of the fashion-piece in the sheer-plan down to the bearding line as ticked; then take the distance from the intersection of the square line at the seating down to horizontal line No. 1, and to where it intersects the bearding line in the direction of the foreside of the fashion-piece, and set it off in the body plan below the horizontal line at the seating of the tuck down the bearding line; strike in the new horizontal line, No. 1, and proceed, as before, to obtain the half-breadth spots on the body plan; then, through all those spots, let a curve pass, cutting its intersection at the bearding line, and it forms the foreside of the fashion piece according to the proposed siding. To this line the mould for the foreside of the fashion-piece must be made, and upon it marked the horizontal line at the seating of the tuck.

Proceed now to make the mould to the aftside of the fashion piece in the body plan, the upper end of which runs up to the height of breadth and cuts off in a horizontal direction; and the lower end cuts off to the horizontal line for the seating and middle line of the stern post: mark on the mould the horizontal lines quite across it and the sirmark which you see crossed upon the mould and stern post, some inches above the seating, the corresponding sirmark being as carefully marked on the stern post; so that, when the heels of the fashion-pieces are letting on to the stern post, those sirmarks must exactly agree; as it will not only be a remaining proof, but prevent any mistake in the height, supposing the workmen to cut the heels too short.

Another mould must be made to the round aft on a square, which must be taken in the direction of the ticked line marked b in the sheer-plan, and that set off square from any line, at pleasure, at the half-breadth at the wing transom; to which sweep the segment of a circle, and it will give the round-aft of the tuck, at any height, square from the rabbet of the stern-post. Let the mould be made of a parallel breadth equal to the siding of the fashion-piece, let the inner end be cut off at the side of the post, parallel to the middle line, and let the outer end correspond well with the upper horizontal line or outside of the fashion-piece; then, when the fashion-piece is to be trimmed, it may be roughly sided on the aftside, so as to lay the aftside mould upon it to cut off the head and heel nearly; the head may be then cut off by the mould the thwartship way, and the fore and aft way may be set off square. Now fasten the round aft mould, that was made to the siding, on to the head of the fashion-piece, by which the fore and aftsides may be trimmed out of winding, by lines parallel to the middle line. We shall then have the best opportunity of seeing how to convert the piece, by seeing both sides at once, and the fashion-piece will then be of a parallel thickness from one end to the other, by all lines that are parallel, whether perpendicular or horizontal.

The bevelling may then be taken at the main breadth by applying the stock of the bevel to the curve of the tuck, and the tongue to its corresponding half-breadth line; another bevelling may then be taken at the horizontal line nearest the seating of the fashion-piece, in the same as the other bevelling; then, when these two bevellings are applied to the fashion-piece, care must be taken to keep the stock of the bevel in the direction of the horizontal lines as marked on the mould; and, when the fashion-piece is trimmed to those two bevelling spots, the mould for the foreside may be applied, and the foreside by that means may be trimmed exactly. As a proof, or a quicker way, trim a spot through at the heel, to fay to the side of the inner post, at the horizontal line at the seating of the tuck; then square that line through to the foreside from the aftside, to which place, the horizontal line marked on the foreside mould at the seating of the tuck must be kept exactly, and the head of the mould well with the bevelling spot set off at the height of breadth. The foreside may then be moulded, as the mould now lies in its proper position.

In smaller vessels, or boats, the planks of the bottom generally run through to the aftside of the tuck; but, in larger vessels, the fashion-piece is generally left large enough to admit of a rabbet at the foreside, to receive the ends of the planks, which is the best and strongest method. The fashion-piece, as here laid down, is conformable to the timbers of the body, both at the fore and after sides, that it might be the more easily understood; but, when the fashion-piece is moulding, care should be taken to leave wood enough, without side the mould, to allow of a rabbet sufficient for the planks of the bottom, which may be found quite near enough for practice, by setting off full the thickness of the outside plank square from the outer edges of the mould, increasing it gradually towards the heel, as the plank there increases more than its real thickness in the direction cut off. In taking out the rabbet on the aftside for the plank that shuts in between the wing transom and the fashion-piece, do not take it out so low down as where it intersects the post, but leave it square some inches above it, that the midship piece may be gotten in its length, and have a proper butt for caulking, as shewn in the body plan Fig. 2.

Leave the fashion-piece sufficiently sided for the wing transom to dove-tail into it on the aft-side, and the foreside of it, that runs above the wing transom, strong enough to receive the bolts and succour the heel of the side counter timber.

§ 13. TO LAY DOWN AND TAKE THE BEVELLINGS OF THE HAWSE PIECES BY HORIZONTAL LINES. (*Plate* 6, *Fig.* 1.)

THESE hawse pieces, when in their places, are supposed to stand perpendicular, and their sides to look fore and aft, exactly similar to the square timbers, but with their sides fore and aft instead of athwartships. Take the siding of the knighthead, the foremost edge of which is represented by the siding of the apron, as the rabbet is on the aftside of the stem, which answers to the bearding line; (but, when the rabbet is in the middle of the stem, then the siding of the stem represents the foreside of the knight-head;) take, also, the siding of the hawse-pieces, from the table of dimensions, and strike them in the half-breadth plan on the floor, letting their lines end against the thwartship view of the foremost edge of cant timber y and filling before it, which will represent the heels of them; then, the water lines, being parallel to the upper edge of the keel, are run in the half-breadth and sheer plans, and may be the horizontal lines for laying off the hawse pieces, with the main and top breadths, and likewise another horizontal line or two between the main and top breadths, as taken from Plates 1 and 2, and represented in Plate 6.

Where the foremost edge of cant timber y and filling before it in the half-breadth plan, crosses the water lines, main and top breadths, and horizontal lines between, square them up parallel to any square timber, to their corresponding lines in the sheer-plan; also, where it intersects the bearding line in the half-breadth plan, square it up to the bearding line in the sheer-plan, let a curve pass through all the spots and the thwartship view of the fore-edge of cant timber y and filling will be represented in the sheer-plan. The filling timber is introduced in order to shorten the heels of the knight-head and two foremost hawse-pieces, and that they may run down without chocks at the heels, and make stronger work.

Where the fore edge of cant timber y and filling before it cross the water lines, main and top breadths, and horizontal lines between, in the half-breadth plan, take those distances square to the middle line, and transfer them to the body plan; setting them off square from the middle line on their corresponding lines; then draw a curve through those spots, and another transferred from the sheer-plan, where it crosses the bearding line, the fore and aft view of the fore-edge of cant timber y and filling will be represented; and, where it intersects the lines of the knight-head and hawse-pieces, is the proper height of their heels, which will agree with the height in the sheer-plan.

As it will be required hereafter to take off the fore edge of the cant-timber y and filling from the middle line in the half-breadth plan, in its cant direction, and where it crosses the bearding line, water lines, main and top breadths, and horizontal lines between, take those distances, and set them off square, from the middle line of the body-plan, on their corresponding lines, and a curve drawn through those spots will represent the line of cant-timber y, and also the filling at the fore edge.

Then, where the lines for the knight-head and hawse-pieces in the half-breadth plan cross the water lines, main and top breadths, and horizontal lines between, square them up to their corresponding lines in the sheer-plan, which will give the spots through which the curves are to pass to represent the moulding edges of the knight-head and hawse-pieces, in their proper places; and where the lines for the knight-head and hawse-pieces meet at the foremost edge of cant-timber y, and filling before it, in the half-breadth plan, square them up to the thwartship view in the sheer-plan, which will give the heels of the knight-head and hawse-pieces in the sheer-plan; and, by drawing of lines thence perpendicularly upwards, will be obtained the direction in which the heels are to be cut off to fay against the foreside of cant-timber y, and also the filling: then, by applying the stock of a bevel to the lines of the knight-head and hawse-pieces, in the half-breadth plan, and the tongue to the line of the fore edge of cant-timber y, and likewise to the filling, we shall find the bevelling to be applied to the heels to trim them the thwartship way so as to fay against the foreside of cant-timber y, and filling before it.

The sides of the knight-heads and hawse-pieces, being parallel to each other, and supposed to fay close to each other, when in their places, in consequence the line or moulding edge of one will serve to counter-mould the other; hence the bevellings may be taken at every sirmark, (that is, at every harpin,) which must be marked on the hawse-piece moulds; and, in order to find their proper stations, take off the knight-head and hawse-pieces from the middle line in the half-breadth plan, and represent them as so many straight lines, parallel to the middle line in the body-plan; then, where the knight-head and hawse-pieces, and square timbers, cross the diagonal lines, take off those heights, and set them off on their corresponding knight-head and hawse-pieces, and square timbers, in the sheer-plan, which will give the horizontal view and proper stations of the harpins on the knight-head and hawse-pieces. Now fix one leg of a pair of compasses in the lines for the knight-head and hawse-pieces at the different sirmarks, and extend the other to the line of the next hawse-piece or after edge, sweeping it till you have the nearest distance, as may be seen in Plate 6, at the 4th or after hawse-piece; which will shew how much the bevelling is within a square in the breadth of the bevelling board, and which should be in breadth equal to what its hawse-piece is sided. The bevellings at the heel, to counter-mould them, must next be taken; in order to which, where the hawse-pieces intersect the fore and aft view of the foremost edge of cant-timber y, level them out to cross the cant-line of the foremost edge of cant-timber y in the body-plan, at which spot erect perpendiculars: then place the stock of a bevel against the perpendicular, and the tongue to the cant-line of the fore edge of cant-timber y, which will give the exact bevelling to be applied on the heel when cut off for counter-moulding the after hawse-pieces, and so on with the others. If this bevelling for the heel was alone set off, and another at the head for the knight-head and hawse-pieces, then the mould for the next hawse-piece aft, by being kept well at the head and keel, and likewise at its proper height, would consequently counter-mould or form the after edge exactly; but this can only be done when the knight-head or hawse-pieces are converted the whole length, or the chock fayed on the heel before it is moulded.

Observe to allow, beyond the mould for the knight-head, its cast forward above horizontal 1, as shewn by the lines in the sheer-plan, Fig. 1; otherwise the inside and outside plank, working through the knight-head, would nearly cut it off. To have this overcast wood still longer, the upper strake, both inside and out, and sheer-strake of round-bowed ships, are not worked through. Allow also, in the siding, what the knight-head may require to open for the bowsprit.

The sheer of the harpins, or ribbands, being run in the sheer-plan, let them be taken off square from the middle line, to their intersection with the square timbers in the body-plan; and those distances set off on their corresponding timbers from the middle line in the half-breadth plan; we shall then have the half-breadth of the ribbands, as shewn horizontally, ending them as before directed: then, where the knight-head and hawse-pieces intersect the horizontal ribbands, square them up to their corresponding harpins or ribbands in the sheer-plan; and, as a proof to the work, you will find them exactly correspond to the lines for the knight-head and hawse-pieces, as before run by the water lines.

§ 14. OF LAYING DOWN AND BEVELLING THE HAWSE-PIECES, WHEN THEY ARE REQUIRED TO BE SIDED LESS AT THE HEELS.

THE hawse-pieces, as described in the last section, were supposed to be sided parallel, or equally, at the heads and heels, and their sides to look fore and aft or parallel to the middle line; and, consequently, they appeared as straight lines when viewed in the half-breadth plan and body-plan. The hawse-pieces now to be laid down are intended to be sided less at the heels than at the heads, but their sides also to look fore and aft; that is, their sides at any particular height are to be parallel to the middle line; but, as the heels are to be sided less than their heads, they cannot therefore appear as straight lines in the half-breadth plan.

Proceed to set off the siding of the heads of the knight-head and hawse-pieces in the body-plan, letting them taper towards the heels as much as may be thought necessary; as, in the body-plan, they may be represented by straight lines, as Fig. 2, Plate 6.

The thwartship view of the foremost edge of cant-timber y, which the hawse-pieces are to end against, must be represented in the sheer-plan by squaring up its intersection with the horizontal ribbands in the half-breadth plan to their respective harpins in the sheer-plan.

The fore and aft view and cant-line of the foremost edge of cant-timber y will be represented in the body-plan by taking off its intersection with the square ribbands, square from the middle line of the half-breadth plan; and, where they intersect the diagonal or ribband lines, square from the middle line in the body-plan, level out lines, and let a curve pass through as before directed; then take its intersections in the half-breadth plan, as before, only on the cant ... same line, and set them off from the middle line in the body-plan upon the lines levelled out, and a curve through those spots will shew the cant-line. Then, the proper heights of their heels will be where the fore and aft view of cant y intersects the lines for the hawse-pieces and knight-heads.

Now take the height of breadth line, beak-head, and toptimber line, at the aftside of the rabbet of the stem, in the sheer-draught, and set them off on the half-thickness of the stem in the body-plan, whereby those lines may be represented in the body-plan, Fig. 2, as they appear round the bow. We may now proceed to shew what form the hawse-pieces will appear in, in the half-breadth plan.

The knight-head was before represented by the bearding line, both in the half-breadth and body plans; but, to shew a difference, we have reduced the apron to the siding of the stem, which must be, if the rabbet were in the middle of the stem; and, of course, the knight-head must fay against the side of the stem, which consequently tapers. Take the distance square, from the middle line in the body-plan, to the heels of the hawse-pieces or their intersection with the fore and aft view of the foremost edge of cant-timber y, and set them off square from the middle line on the foremost edge of cant-timber y, in the half-breadth plan, which will give the heels of them there; then take the distance square from the middle line in the body-plan, to where the hawse pieces cross the diagonal ribband lines, main and top-breadth, and horizontal lines between, and set them off square from the middle line in the half-breadth plan on their corresponding horizontal ribband lines, main breadth, &c.: then, by drawing curves to pass through the spots so set off, they will shew the form that the hawse-pieces and knight-head would appear in, to an eye directly over them and looking down upon them, occasioned by the different curves of the body when cut by those sections.

Proceed, in the next place, to shew the form of the body, supposing it to be cut by the different sections of the hawse-pieces, to which form the moulds are to be made to trim them. Where the hawse-pieces in the half-breadth plan intersect the horizontal ribbands, (or horizontal water lines, if run,) main and top breadths, and horizontal lines between, let them be squared up to their corresponding lines in the sheer-plan; also, where they end against the foremost edge of cant-timber y, in the half-breadth plan, let them be squared up to the thwartship view of the foremost edge of cant-timber y in the sheer-plan; or, which is more correct, where they intersect the fore and aft view of the foremost edge of cant-timber y in the body-plan, take those heights and set them off on the foremost edge of cant-timber y in the sheer-plan; both of which will give the spots for the heels of them in the sheer-plan. Then, by drawing curves to pass from the last-mentioned spots, through the other spots set off, the moulding edges of the hawse-pieces, and the aftside of the rabbet for the knight-head, will be represented in the sheer-plan, shewing them as they appear when in their places. To be more exact, and supposing the hawse-pieces to taper much more than these do, the heights of the harpins, main breadth, &c. should be taken in the direction of the hawse-pieces, as they appear in the body-plan, from the intersection of the heel with the fore and aft view of the foremost edge of cant-timber y, and that height should be levelled out in the sheer-plan as at the moulding edge of the 4th hawse-piece. Then set up those heights in the sheer-plan, above the line levelled out at the heel, upon perpendiculars raised at the intersection of the hawse-pieces at the harpins, &c. as now run in the sheer-plan; and, whatever alterations these new heights produce, are the real curves to which the moulds ought to be made, and the exact heights of the sirmarks of the harpins, &c. to be marked on the moulds.

The method of bevelling these hawse-pieces is done in the manner described in the last section; for, although they do not appear the same in the half-breadth plan, yet in the sheer-plan (their sides looking fore and aft) you see the form of them square from the plans of their separate sides; therefore the distance at which they appear from each other in the sheer-plan, at each harpin, is the proper bevelling of them, agreeably to their distance from each other, taken at their corresponding lines in the half-breadth plan.

Where the heels of the knight-head and hawse-pieces step on the thwartship view of the foremost edge of cant-timber y, in the sheer-plan, draw them up perpendicular; which gives the direction for cutting off the heels to fay against the foremost edge of cant-timber y; and, to bevel the heels of them, the tongue of the bevel must be placed to the foremost edge of cant-timber y in the half-breadth plan, and the stock kept in a fore and aft direction parallel to the middle line, as at the 4th hawse-piece.

To find the bevelling of the heel, to be applied when the heel is cut off by the last bevelling, in order to counter-mould the hawse-pieces; level out the heels of the hawse-pieces at their intersection with the fore and aft view of the foremost edge of cant-timber y, to the cant line of the foremost edge of the same timber in the body-plan, and there raise perpendiculars, to which apply the stock of a bevel, and the tongue to the said cant line, which will give the bevelling of the heel, in order to counter-mould the knight-head or hawse-pieces: when cut off, this may be said to be near enough for the tapering of the present hawse-pieces; but, were they to taper much more, the side of the 4th hawse-piece would consequently incline much nearer to the middle line at the heel. To be exact, take the height from the horizontal line at the heel to where the second futtock-ribband intersects the moulding edge of the 4th hawse-piece, in the direction of the said edge in the body-plan, and set it up parallel to the horizontal line at the heel in the sheer-plan. Then take the nearest distance from the middle line in the body-plan to the intersection of the second futtock-ribband, where you will see a spot, and set it off square from the middle line on the half-breadth plan on the fore edge of cant y; square up this intersection to intersect the last horizontal line drawn in the sheer-plan, and strike a line thence to intersect the heel of the hawse-piece, No. 4, as ticked in the plate, which gives the exact line to which the heel must be cut off to fay against the fore edge of cant y. Take the distance from the middle line in the half-breadth plan, in the direction of the fore edge of cant y, to the last-mentioned spot, and set it off from the middle line in the body-plan on the last horizontal line there struck; and, from its intersection, draw a line, as ticked, to the heel of the timber, which is likewise the line to which the stock of the bevel must be applied, to give the bevelling of the heel to counter-mould the hawse-pieces.—To mark the true stations of the hawse-pieces on the harpin-moulds, see Section 16, hereafter.

§ 15. TO LAY DOWN AND BEVEL THE HAWSE-PIECES BY HORIZONTAL LINES; OR THE HORIZONTAL RIBBANDS, WHEN CANTED.

THE method of laying down and disposing of the hawse-pieces, which we are about to shew in this section, is the most complete of any, as it is the best for the strength of the ship, and will likewise assist the conversion of the timber; for, by canting them, they will be diminished at the heels, whereby a less piece of timber will do the same service as a larger; and, as the canting and diminishing of them at the heels is performed by one operation, they consequently must appear as straight lines when viewed in the half-breadth plan; and it must be allowed, that all timbers, when canted nearer to a square with the body, add more to the security of the plank, and the timbers are not wounded so much by that security. The canting of the hawse-pieces is also some advantage to the hawse-holes; for although the hawse-holes are generally cut nearly parallel to the middle line, yet this method leaves most wood at that side of the hawse-hole which is the farthest from the middle line, and is the wearing side of the hawse-hole.

Proceed to dispose of the hawse-pieces in the half-breadth plan, giving them a proper cant, by letting the heels be sided less than the heads, and representing them by straight lines; as Fig. 3. Plate 6. Then shew the thwartship view of the foremost edge of cant-timber y in the sheer-plan, as before described; likewise the cant line of the same timber in the body-plan: Then, where the hawse-pieces intersect the water lines and horizontal No. 1, likewise the main and top breadths in the half-breadth plan, square them up to their corresponding lines in the sheer-plan; also, where they intersect the line of the foremost edge of cant-timber y in the half-breadth plan, square them up to the thwartship view of the foremost edge of the same timber in the sheer-plan; through these spots let curves pass, which will give the exact thwartship view of them as ticked in the sheer-plan, supposing they were in their places; but, as the sides do not look fore and aft, these are not the proper lines to make the moulds to, but will be serviceable hereafter, to get the proper heights of the main and top breadths, as likewise of the harpins, to be crossed on the hawse-piece moulds, the moulding edge of the knight-head being shewn by the aftside of the rabbet, as observed in the last section.

Now take the distance, in their cant direction, from where the knight-head and hawse-pieces intersect the foremost edge of cant-timber y in the half-breadth plan, to where they intersect the water lines and horizontal No. 1, and set them off from the middle line in the body-plan on their corresponding horizontal lines; but, as the main-breadth line is not a horizontal line in the sheer-plan, its several heights where it crosses the thwartship view of the knight-head and hawse-pieces in the sheer-plan, must be taken and transferred to the body-plan; drawing horizontal lines at each height. Then take the distance from where the knight-head and hawse-pieces intersect the foremost edge of cant-timber y in the half-breadth plan, to where they intersect the main half-breadth line in their cant direction, and set them off from the middle line in the body-plan on their corresponding heights last levelled out; next take the height where the heels of the knight-head and hawse-pieces intersect the thwartship view of the foremost edge of cant-timber y in the sheer-plan, and transfer them to the middle line in the body plan; whence let curves pass through the other spots set off, and they will represent the proper form of the knight-head and hawse-pieces, to which lines the moulds are to be made.

The proper stations of the harpins to be marked on the moulds may be had in the following manner: run the horizontal or thwartship view of the harpins in the sheer-plan, as before directed, which is the exact height of them when in their places; then, where they intersect the thwartship view of the knight-head and hawse-pieces is the exact height to be transferred from the sheer-plan to their corresponding hawse pieces in the body plan; and this gives the exact stations of the harpins to be crossed on the knight-head and hawse-piece moulds.

These hawse-pieces must be bevelled, by laying down a parallel line to the siding, as done for the cant timbers or cant transoms; therefore, draw a line parallel to the joint of the fourth hawse-piece, in the half-breadth plan; and, where the line for the joint of the fourth hawse-piece intersects the foremost edge of cant timber y; square a line thence to the parallel ticked line, which, for distinction, call the heel of the bevelling edge, then take the distance from the heel on the bevelling edge to where the water lines and horizontal No. 1; intersect and set them off from the middle line on their corresponding horizontal lines in the body plan. Where the bevelling edge in the half-breadth plan intersects the main half-breadth line and foremost edge of cant timber y, square them up to the height of breadth, and thwartship view of the foremost edge of cant timber y in the sheer-plan, and thence transfer those heights to the middle line in the body plan, drawing horizontal lines; then take the distance from the heel of the bevelling edge in the half-breadth plan to the main half-breadth line and foremost edge of cant timber y, in the direction of the bevelling edge, and set them off from the middle line in the body plan at their respective heights last levelled out; then, by drawing a curve through those spots so set off in the body plan, the bevelling edge of the fourth hawse-piece will be represented. Whatever distance the moulding edge is from the bevelling edge in the body plan, taking the nearest distance, so much is the bevelling under from a square, at the different harpins d c c in the breadth of the bevelling board, which must be in breadth the same as the distance from the moulding edge to the bevelling edge in the half-breadth plan, taking it on a square. In the same manner proceed with the other hawse-pieces, and likewise with the knight-head, and the bevellings of all may then be taken.

But, as the water lines are not always parallel to the upper edge of the keel, consequently not horizontal in the sheer and body plans, neither is it customary to run the water lines upon the floor, but the horizontal or square ribband lines must be run for the purpose of laying off the cant timbers; therefore, it is absolutely necessary to shew the method of laying off the cant hawse-pieces by the horizontal or square ribband lines, though attended with much more trouble. But this method does not require the thwartship view of the hawse-pieces to be shewn in the sheer-plan.

But, to proceed, take square from the middle line, in the half-breadth plan, the intersections of the lines representing the knight-head and hawse-pieces at the horizontal ribband lines, and set them off square from the middle line in the body plan to where they shall intersect their respective diagonals or ribband lines; and, at those places strike horizontal lines. Then take the distances in the direction of the lines representing the knight-head and hawse-pieces, in the half-breadth plan, from their intersection at the foremost edge of cant timber y, to where they intersect the horizontal ribband lines. Then set off those distances from the middle line in the body plan, on each respective horizontal line last drawn, (which horizontal lines will be found to agree with the heights at the intersection of the thwartship view of the hawse-pieces with their respective ribbands, as laid off by the horizontal water lines in the sheer-plan). The thwartship view in the sheer-plan and cant line for the foremost edge of cant timber y in the body plan being already laid off, the fore and aft view in the body plan is not required in this operation.

The heels, main and top breadths, and horizontal lines between, are laid off exactly as shewn in the last section, by the horizontal water lines and curves being made to pass through those spots, which will be found to agree with those already run by the water lines in the body plan, and likewise the stations of the ribbands to be marked on the moulds. To bevel the knight-head and hawse-pieces, by the horizontal ribband lines, proceed to lay off the bevelling edge and square over the heel as before directed; and, to prove how it will agree, we will lay off the bevelling edge of the fourth or after hawse-piece. Take the distance square from the middle line, in the half-breadth plan, to where the horizontal third futtock ribband intersects the ticked line, or bevelling edge, and set it off square from the middle line in the body plan to where it shall intersect the third futtock ribband line; there strike a horizontal line, and then take the distance from where the heel of the bevelling edge intersects to where it crosses the third futtock horizontal ribband line in the direction of the bevelling edge in the half-breadth plan, and set it off from the middle line in the body plan, upon its corresponding horizontal line last drawn there, and mark a spot. Proceed the same with the horizontal second futtock ribband line, in the half-breadth plan, and produce its horizontal line and spot in the sheer-plan. The operation is only shewn at the third futtock ribband to prevent confusion. The spot at the heel intersecting the foremost edge of cant-timber y, at the bevelling edge, is the same operation as by the horizontal water lines, and need not be repeated here; but, as only two spots have been obtained by the horizontal ribbands, continue the ticked line or bevelling edge farther aft, so as to intersect the horizontal floor ribband line in the half-breadth plan. Then take the distance square from the middle line, as before, to the intersection of the bevelling edge with the horizontal first futtock ribband line in the half-breadth plan, and set it off square from the middle line in the body plan, to where it shall intersect the first futtock ribband line: draw there a horizontal line, then take the distance from where the heel of the bevelling edge intersects the ticked line or bevelling edge; and, in that direction to where it intersects the horizontal first futtock ribband, set it off to the left hand of the middle line in the body plan upon its horizontal line last drawn: by these means another spot is obtained; and, proceeding thus with the floor-ribband, let a curve pass through these and the other spots. The bevelling edge may be run as low down as the moulding edge, or the moulding edges may be continued lower down in the same manner, and prove the heights at the heels. It may be proper to observe, that the same may be done by the horizontal water lines. The bevelling edge above the diagonal ribbands is run as in the operation by horizontal water lines.

When the knight-heads and hawse-piece moulds are made, cross the middle line of the body plan upon the moulds (or, which is best, cut off the heel of the mould well with the middle line) which will give the direction required for cutting off the heels, in order to fay them against the foremost edge of cant-timber y, and to take the bevelling for cutting off the heels to fay against the foreside of cant-timber y the thwartship way. Apply the stock of the bevel to the lines of the moulding edges in the half-breadth plan, and the tongue to the foremost edge of cant-timber y; and, to find the bevelling of the heel to countermould them when cut off, proceed as described in the former sections.

The directions for marking the stations of the hawse-pieces on the harpin moulds will be found in the next section.

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§ 16. OF THE NATURE AND USE OF THE HARPINS WITH THE VARIOUS METHODS OF LAYING THEM OFF, AND TAKING THE BEVELLINGS. (*See Plate* VII.)

THE ribbands to which the harpins are connected reach along the ship fore and aft, but in the wake of the cant bodies, or at the fore and aft part of the ship, they are termed harpins, and are trimmed to the shape of the ship's body by moulds and bevellings from the mould loft. The ribbands and harpins are canted, or placed diagonally, similar to the cant-timbers, and for the same purposes. First, it is the best conversion; secondly, for shoring and better securing the timbers until the plank is on, being nearly square from the timbers. The upper ribband that is shored, is so placed that the main wales may be wrought and shored before that ribband is disturbed; and, indeed, the nearer the ribbands approach the direction in which the planks are to be wrought, the better; because the planks themselves, when wrought, become as ribbands, and may be shored before the ribbands immediately below them need be disturbed.

To understand the canting of the ribbands more clearly, what was said in Section 4, in order to quicken the ideas of the student with respect to the cant-timbers, may be observed with respect to the ribbands; for, where they intersect at the middle line, suppose them hung with hinges; and, instead of swinging vertically at a cant-timber, to swing upwards or downwards, as the flap of a table, the middle line or joint being an horizontal line, which will be the case all fore and aft if they are at the same heights in both bodies as at first futtock harpin, Plate 7. also, suppose the diagonal line as drawn, to represent the ribband in the body plan, Plate 7. to represent the edge of a large surface, the breadth of which is equal to the distance of the line of the same cant-ribband on the half-breadth plan, from the middle line, and the fore and aft view of that surface to be represented by that one line; it immediately follows, that the surface must stand horizontal: then, if we describe the proper shape of the first futtock cant-ribband, as represented in the half-breadth plan, upon this surface (keeping its position) then cut it out and afterwards lower it to its diagonal position, it will exactly cover the horizontal view of the same ribband, as described in the half-breadth plan; and we shall have the true situation of the cant-ribband as in its place on the ship. (Except the difference between a plain surface and the sheer of the ribbands upon the ship which shall be pointed out at the close of the Section.) Whereas, when lifted up, as before, to its horizontal position, it exactly agrees to its cant-ribband as laid off on the half-breadth plan, to which line the mould for the harpins must be made, as represented at the third futtock harpin, Plate 7. by the ticked line marked outside of the mould in the half-breadth plan. As all the moulds are similar, this may suffice.

The ribbands, that they may support the timbers until the plank is brought on, are generally spaced as follows. The floor ribband is generally placed above eighteen inches below the floor-heads, and sometimes one below that, which supports the heels of the lower or first futtocks called the lower ribband (if a harpin is not made to it, it is useful as a bevelling spot). The next above the floor-ribband is the first futtock ribband; generally placed midway between the floor and first futtock heads, which supports the first futtock heads and second futtock heels. The next above is the second futtock ribband, which is placed midway between the first and second futtock heads, and supports the second futtock heads and third futtock heels. The next above is the third futtock ribband, which is placed midway in the midships between the second and third futtock heads, and supports the third futtock heads and fourth futtock heels: this is the upper ribband that is shored, and is so placed forward, that it need not be disturbed until the main wales are wrought and shored. To support the timbers of the topside, above the main breadth, let a ribband be placed about nine inches below the range of the ports of each deck; so that the lower sills may be let out clear of the ribbands: and, lastly, another ribband is placed along the sheer with its lower edge well with the toptimber line, or nearly so, so that the under sheer strake may be wrought before it is disturbed. This is commonly a larger ribband, like that at the floor head, to keep the topside fair.

The harpin moulds being made, mark the stations of the cant-timbers upon them thus. Where the cant-timbers intersect the horizontal or square ribbands, square them up to their corresponding cant-ribbands in the half-breadth plan, as at the third and second futtock harpins; then, striking a straight line from the intersection of each cant-timber, at the middle line of the half-breadth plan, to their corresponding stations just squared up, will give the direction of the cant-timbers as they stand with the harpin mould, as at cant-timber u, second futtock harpin.

The common method of taking the bevellings is, at every square timber, which must be also marked on the harpin mould, as they lie in their places on the floor. The stations of the square timbers making no alteration, because the harpin is lowered in a perpendicular direction. Fix the stock of a bevel well with the ribband or harpin line in the body plan, and the tongue against the outside of the square timber as at o, third futtock harpin, and so on with the other timbers, marking each of them, and the name of its respective timber on a board (the board to be as broad as the harpin is sided or deep) which gives the bevelling of the harpin at each timber: then fix the stock of the bevel upon the same harpin line in the body plan, and the tongue against the side of the stem, and mark that likewise upon the board; and, by that bevelling the foremost end of the harpin must be trimmed to fay against the stem. The fore and aft part of the harpin, against the stem, is obtained by the foot or swell on the fore end of the harpin mould, which is cut off well with the half thickness of the stem, parallel to the middle line. Another bevelling is taken and applied over the end after it is cut off to the fore and aft line, and bevelled against the stem thus: fix the stock of a bevel upon the horizontal line of the harpin upon the stem, and the tongue to the aftside of the rabbet of the stem, as at the third futtock harpin in the sheer-plan, and a sirmark is made on the mould where the half thickness of the stem shall intersect, to this sirmark the bevel is to be applied as may be seen in the plate, particularly at the lower harpin lines, which end in the middle of the rabbet, as the floor and lower harpins.

To fix the harpins well at the stem, let the foreside of the rabbet of the stem be squared down upon the mould, marking there a sirmark, which must, of course, agree with the foreside of the rabbet of the stem upon the ship when the harpin is in its place.

This method of taking the bevellings for the harpins is something similar to the taking of the bevellings of the transoms to the buttock lines on the sheer-plan: for, unless the stock of the bevel is held in the direction of the square timbers, as marked on the mould, and the tongue square from the upper edge, error will be inevitable. Let the lower edge of the harpin be run on the half-breadth plan, and the bevellings may be applied square from the mould at every other cant-timber; the square timbers need not be marked upon the moulds at all.

Strike a line at the depth or siding of the harpin, below the harpin line, as at the first futtock harpin in the body plan; and, at its intersection with the middle line, square a line to its under edge: then fix a batten at the intersection of the square line, and mark upon it the intersections of all the square timbers with the under edge (or ticked line). Set them off, on their corresponding timbers, from the middle line of the half-breadth plan, and pin a batten to those spots: the batten will form the curve marked bevel edge as at the first futtock harpin. Now, by sweeping the nearest distance with a pair of compasses, from the cant line to the under edge at any place, will be obtained what the bevelling is from a square at that place. If towards the middle line, it is so much under from a square; and, where it is without the cant-line, it is, of course, so much without a square or standing bevelling: but, as it would require much trouble to apply these bevellings as now taken, they must be all reversed when marked on the board.

But, to run the under edge in the half-breadth plan, without the trouble of reversing the bevellings, take a square and fix the stock to the harpin line as at square timber O, floor harpin in the body plan, and take, with a pair of compasses, what the outside of the timber is within or without a square at the under edge of the harpin in the direction of the ticked line; set it off within or without the cant line, on its corresponding timbers, in the half-breadth plan, and a batten pinned to those spots, will give the bevelling edge as at floor cant harpin: then, with compasses, take off the distances and mark them within or without the square in the breadth of the bevelling, at every other cant-timber, or at pleasure, marking the bevelling places on the mould.

Take the heights in the body plan, where the diagonal harpin lines intersect the square timbers and half-thickness of the stem, and set them off on their corresponding square timbers and stem in the sheer-plan; and, through those spots draw curves, which will represent the horizontal view of the harpins in the sheer-plan. Then, where the cant-timbers in the half-breadth plan intersects the horizontal or square ribband lines, bearding line, main and topbreadth lines, &c. square them up to their corresponding lines, (making spots) in the sheer-plan. The curves which these spots give, will represent the thwartship view of all the cant-timbers in the sheer-plan.

To lay off the harpins, when placed to the sheer of the ship, and to answer to the exact form of the ship's body when put in their places, we must proceed as follows. But, in order to convey a just idea of the alteration they will make in hanging to the sheer of the ship, we may suppose the ship to be cut athwartships, in the direction of the curve of the harpin, at the lower port cills, as it appears in the sheer-plan, and a mould made in the same harpin in the half-breadth plan, broad enough to cut off at the middle line with the stations of the timbers marked upon it as before directed; then apply the mould to the ship, supposing it to be cut off as before mentioned, keeping it well at the stem, and likewise at the middle line; then, by pressing it down to the curve of the sheer of the ship, we shall perceive the stations of the timbers as marked on the mould, to draw before their real stations as disposed of in the sheer-plan, which consequently will make the bows of the ship too full for the proper form of the body.

Now, to lay them down, in order to make the moulds with exactness, proceed in the following manner: Where the stations of the timbers intersect the port sill harpin, draw lines a little aft, parallel to the middle line in the half-breadth plan: then fix one end of a batten to the aft part of the rabbet of the stem in the sheer-plan, and extend the batten to the curve of the harpin, at the lower port sill, marking on it the timbers; then keep the batten fast at the rabbet of the stem, and lift the after end of it till it is in a horizontal position, or parallel to the keel; as the ticked line at the port sill harpin. From the latter square down the stations of the timbers to the line squared aft in the half-breadth plan, and their intersection gives the spots in the half-breadth plan through which the curves are to pass, that will represent the true form of the harpins, and to which lines the moulds for the harpins ought to be made. Those spots will also be the true stations of the timbers to be marked on the harpin moulds, as may be seen at the harpin marked lower port sill harpin to the hang of the sheer, and at each spot, or intersection, are marked the names of the timbers respectively.

The harpins at the aft part of the ship may be laid off in the same manner, and therefore require no farther description.

Having explained the method of crossing the cant-timbers on the harpin moulds, the stations of the hawse-pieces may likewise be marked thus; where the hawse-pieces intersect the horizontal ribbands, square them upwards to the cant ribbands from the middle line in the half-breadth plan, which is the station to be marked on the moulds, as may be seen in Plate 7.

But, when the harpin moulds are made to the hang of the sheer, as last described, draw a line aft at each intersection, parallel with the middle line in the half-breadth plan, where they intersect the harpins at the ports, &c. Then take off each of those spots from the aft-side of the rabbet of the stem agreeably to the hang of the harpin, and set them off upon the horizontal line of the same harpin from its intersection of the rabbet; then square down also the spots from the horizontal line in the sheer-plan, to intersect the lines squared aft from the intersection of the hawse-pieces in the half-breadth plan, which give spots to form the true curve of the harpin round the bow, and the true stations of the hawse-pieces to be marked on the harpin mould, as marked 1, 2, 3, 4, at the dotted line representing the harpin, as laid off to the hang of the sheer in the half-breadth plan.

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§ 17, OF LAYING DOWN THE SEVERAL PARTS OF THE HEAD. *(Plates 3 and 7.)*

THE laying off the beak-head timber having not yet been mentioned, we shall introduce it here. Strike a horizontal line across the fore-body plan, as in Plate 3, at the height of the beak head; and, from the middle line, take off on a batten its intersections with the square timbers O, Q, S, U, X, and proof-timber, and set them off from the middle line of the half-breadth plan on their corresponding timbers ending (as any other horizontal line) at the aft-side of the rabbet of the stem squared down from a horizontal line at the height of the beak-head in the sheer-plan. In the same manner, run the horizontal lines 2 and 1; the last is struck when the outside edge or heel of the mould shall intersect the diagonal at the third futtock head. For the beak-head timber should always be made by a top-timber (as it would be almost impossible to form it by a fourth futtock without scarphing it). Square down, from the sheer-plan, the fore-side side of the beak-head to the middle line of the half-breadth plan, whence take off its intersections with the horizontal lines 1, 2, beak-head, and toptimber breadth, and set it off on its corresponding lines from the middle line in the body-plan: a curve made to those spots will represent the beak-head timber as a square timber in the body-plan, to which we intend to make the mould; and, to its moulded size, or inside and outside edge, as there shewn. Upon the said mould mark the horizontal lines 1, 2, and beak-head, letting the head of the mould run well up above the top-side line to receive the main rail (and form a proper head for the anchor stopper) as shewn in the body-plan. Then take the bevelling at each horizontal line from the foreside of the beak-head in the half-breadth plan, as shewn by the bevel at horizontal 1, and set it off from the out-side edge at horizontal line 1 in the body-plan. Then strike the cant-line of the beak-head timber, which is x, from its intersection at the middle line of the half-breadth plan, to where the foreside of the beak-head intersects the horizontal line at the beak-head in the half-breadth plan. Then take the distance from the foreside of the bead-head to the cant-line at and in the direction of horizontal line 1 in the half-breadth plan, and set it off from the outside edge upon the bevel-ling last set off at horizontal 1, in the body-plan, making a spot; and it will be found to agree with the intersection of the fore and aft view of the cant-timber x. Then take the bevelling of the cant-line x from a thwartship line, or any square timber, as at w in the half-breadth plan, and set it off below horizontal line 1 in the body-plan, so that it may intersect the last spot there set off, which may be proved by continuing it to the middle line. Next take the distance on the cant from the middle line of the half-breadth plan to where it shall intersect horizontal lines 1 and 2, and set it off from the middle line of the body-plan respectively on the cant-lines or bevelling then shewn, and each distance will meet in the fore and aft view.

Then, upon this bevelling, or cant-line, square down the outside and inside edge of the square beak-head timber in the body-plan (as you find represented by two spots at horizontal line 1); then take their distance on the cant-line, and set it off within the intersection of the two bevellings, (or fore and aft view of cant-timber x,) and, by drawing a line thence to the inner edge of the mould, will form a bracket which, if nailed on the aft-side and square from the mould, will give what the beak-head timber will cant from a thwartship line at horizontal line 1. Proceed in the same manner at horizontal line 2, and the bracket as shewn there in the body-plan will be likewise obtained; which, if nailed to the mould, as at horizontal line 1, will give likewise what the timber cants at horizontal line 2. For clearness, we have only shewn two horizontal lines below the beak-head, but it will be clear, upon inspection, that one more between each may be laid off upon the floor if thought necessary.

When the timber is to be moulded, the mould is to be laid upon the foreside of the piece and a parellel mark taken from the under side of the mould above the beak-head, and the same from the under side of the brackets; then lined straight each way, the lower part at the inner edge must break in with a fair hance at the beak-head line; then the foreside of the timbers may be trimmed or sawed straight through, to each edge. The mould may then be laid on, and the edges rased by, as low as the beak-head; and, below that, a spot made at the side of each bracket, and a batten pinned to those spots, to break in fair at the beak-head line, will mould the timber on the foreside at both edges. The bevellings may then be set off at horizontal lines 1 and 2, as taken from the half-breadth plan, from the foreside of the beak-head (as before directed at horizontal line 1) and applied from the upper side and outer edge of the mould (which will be found to agree with the outsides of the brackets); but the bevellings at the beak-head, and all above, had better be taken from the body-plan; thus, set off the aft-side or siding of the beak-head timbers in the half-breadth plan, and take off its intersections with the horizontal lines square from the middle line in the half-breadth plan. Set them off on their corresponding lines from the middle line in the body plan, and form the ticked line or bevelling edge: now, as the beak-head timber is square or athwartships above the beak-head line, as many bevellings may be taken as thought necessary, by taking the nearest distance with compasses from the outside line of the beak-head timber to the ticked line (or bevelling edge) and so much standing or without a square is the beak-head timber from a thwartship line at each place where taken, which must be marked on the mould as sirmark 1, 2, 3, and head, and the outside of the timber trimmed to it. The foreside and outside being trimmed, set off the siding of the timber, and trim the aft-side below the beak-head to the cant, and above the beak-head to look athwartships, or parallel to the foreside: the twist being very great, must be gradually reconciled to give it an agreeable appearance. The inside may then be trimmed, by taking the scantling from the foreside and applying it on the aftside, and trimming it straight to each edge fore and aft.

The HEAD, as shewn in the sheer-draught, is taken off thence and represented on the mould-loft floor, in its proper place in the sheer-plan, forming the rails, cheeks, knee, and every other part, exactly similar to the lines on the sheer-draught, as in Plate 7. (But, in mould-lofts where there is not sufficient room, take off from the sheer-plan about as much as is represented in Plate 7, and it may be laid off in any convenient part of the mould-loft). This will be the exact horizontal and thwartship view of the head; that is, as it appears on the ship, when the rails, &c. are in their places, and viewed in a horizontal and thwartship direction. The first thing required will be to find the exact form of the rails, as they will appear when viewed in a direction square to their sides, which consequently will be the form to which the mould must be made.

Continue the middle line of the half-breadth plan as much farther forward from the stem as the length of the head, as in Plate 7; then square down from the sheer-plan to the middle line of the half-breadth plan the foremost end of the upper rail (as the ticked perpendicular in the plate), and set off on it, from the middle line, the half-breadth of the lacing; from which place to where the beak-head line intersects the outside of the plank at the top-breadth line, strike a straight line, which will represent the inside of the main or upper rail in the half-breadth plan, as supposing that we were right over it, and looking down upon it; then set off the siding of the rail at the after end and foremost end, and represent the outside by another straight line; and, as the outside is the sight side, or that part which appears when viewed on the ship, it will therefore be the properest side to lay down.

In the next place, strike a horizontal line in the sheer-plan, at the height of the upper part of the foremost end of the main rail, and let it be continued to the after end of the said rail; then drop perpendiculars to the aftsides of the head-timbers to intersect the said horizontal line, and one or two more between the head-timbers from the upperside of the upper cheek to the horizontal line, and also one or two between the after head timber and the after end of the main rail; disposing of them all in such a manner as to be nearly at equal distances; then square down the said lines, from the horizontal line in the sheer-plan to the middle line of the half-breadth plan; and, where they shall intersect the outside line of the main rail in the half-breadth plan, square them out from the said outside line; then take the distance from the horizontal line in the sheer-plan, to the upper edge of the main rail at each perpendicular line, and set them off from the outside line of the main rail in the half-breadth plan, on their corresponding squared lines, as you see numbered from the foremost end; a curve then passing through these spots will shew the exact form of the upper edge of the main-rail. Now, while the batten is pinned to the spots set off for the upper edge of the main-rail, mark on it the fore end and all the squared lines and after end; then take the batten, and lay it straight against one of the perpendiculars as at u, and mark off each spot numerically: then, at each end, set off the moulded size or depth of the rail, and strike a straight line. Next, with compasses, take off the size at each place, as numbered, and set it off from its corresponding place square from the upper edge represented in the half-breadth plan: a curve formed to those spots gives the lower edge; and, the main-rail mould being made agreeably to those lines, when put in its place, will appear exactly the same as the main rail represented in the sheer-plan.

When the lines squared out from the middle line in the half-breadth plan intersect the inside line of the main-rail, draw them thence square from the outside line to the rail already laid down; then take the distance from the outside line, on the lines last squared, to the upper edge of the rail, and set them down from the horizontal line in the sheer-plan on their corresponding squared lines, which will give spots that will shew the inside upper edge of the main rail in the sheer-plan, which is seen from the middle of the rail forwards; and, because the after part falls below the outside, and therefore cannot be in view, it is only ticked on the plate. The inside of the rail, at the lower edge, should also be set off in the same manner in the sheer-plan, in order to lay down the head-timbers.

Set off from the line representing the inside of the main-rail in the half-breadth plan, the thickness of the underside of the rail, as it will be when chamfered, and draw a straight line, which must be laid down in the sheer-plan; because, in a thwartship view, this is the proper sight of the lower edge of the rail; therefore the lower part of the rail in the sheer-plan, which was first shewn, in order to lay down the rail to its proper spread in the half-breadth plan, may now be rubbed out, as the rail is now supposed to be chamfered or wrought.

Where the lines squared out from the middle line in the half-breadth plan intersect the chamfered line last drawn, draw them thence to the lower edge of the rail laid down square from the outside line; then take the distance from the outside line to the lower edge of the rail laid down, on each of the lines last squared out, and set them off from the horizontal line on their corresponding square lines in the sheer-plan, which will give the lower edge of the rail at the chamfer, as it will appear when trimmed and in its place.

In the next place, proceed to lay down the after head-timber, (or stem-timber,) as we cannot, till that is determined, set the spread of the lower rails. In the half-breadth plan set off the half-thickness of the knee of the head, and lay off the upper cheek. Then, in the most convenient place that is clear of the other lines, strike an horizontal line which may represent the lower part of the after head-timber, or upper part of the upper cheek, at the line for the aftside of the after-timber in the sheer-plan; then take the heights from the upperside of the upper cheek at the aftside of the after-timber, in the sheer-plan, to the upper and lower outside edges of all the rails, and set them up from the last horizontal line laid down, striking other horizontal lines to each height; then, from the lower horizontal, or base line, square up a line which will represent the middle line of the head-timber, as at square-timber Q in the sheer-plan, Plate 7. Next take the distance from the middle line in the half-breadth plan, at the line squared down from the aftside of the head-timber, to the outside of the main rail, and likewise the inside, and also the line for the chamfer of the rail at the underside, and set them off from the middle line of the after head-timber on their corresponding heights or horizontal lines; and, at those spots, square down lines to the depth of the rail; then take the heights from the upper side of the upper cheek, at the aftside of the after-timber, in the sheer-plan, to the upper and lower inside edges of the rails (as shewn in ticked lines on the main-rail), and set them up from the base line upon the inside of the rail squared down in the plan of the after-timber; then, allowing for the square and moulding chamfer outside, the thwartship section of the main-rail may be shewn.

Observe, at the aftside of the after head-timber, in the sheer-plan, that the main rail is horizontal and square from the inside, consequently the inside edges do not appear: but, as the operations for taking off and laying down the edges of the head-timbers are similar, the student is referred to the preceding instructions, in order to avoid needless repetition.

Now take the distance from the middle line in the half-breadth plan, at the line for the aftside of the after head-timber to the outside of the upper cheek, and set it off from the middle line on the base line in the plan of the after head-timber; from which spot design a curve that shall make an agreeable hollow to the inside under edge of the section of the main rail, which forms the outside of the timber: then, to complete the moulded side or inside of the timber, take off the half-thickness of the knee of the head from the middle line at the aftside of the timber in the half-breadth plan, and set it off from the middle line on the base line in the plan of the after head-timber, and square it upwards. Then, from the upperside of the upper cheek, at the aft-side of the timber in the sheer-plan, take the height of the cutting-down of the knee, and set it up from the base line on the line squared up for the inside of the heel of the timber; thence an inflected curve to the upperside of the section of the main-rail will complete the moulded side of the head-timber.

The aftside of the after head-timber being laid down, we may now determine on the spread of the lower rails in the half-breadth plan; therefore, take the distance from the middle line in the plan of the after head-timber to where the outside curve of the head-timber intersects the lower horizontal line of the middle and lower rail, and set them off on the line squared down for the aftside of the after head-timber from the middle line in the half-breadth plan, then square down to the middle line of the half-breadth plan the fore ends of the middle and lower rails, (that is, where the uppersides of the said rails intersect the aftside of the hair-bracket); then, where the fore ends cut the half-thickness of the lacing in the half-breadth plan, set off the thick-ness or siding of each rail at its respective fore end, and make a spot from the inside edge to which the rail is to be chamfered; then strike a straight line from the last spot to that set off on the aftside of the after head-timber, and we shall have the lines for the chamfered edge of the lower rails, as represented by ticked lines in the half-breadth plan: then, at the after ends set off the thickness or siding, and strike straight lines to the siding at the fore ends: we shall then have the inside and outside lines of the middle and lower rails as represented in the half-breadth plan, Plate 7. Next proceed to strike a horizontal line for the middle and lower rail in the sheer-plan, at the height where their foremost ends, at the uppersides, intersect the aftside of the hair-bracket; then may the middle and lower rails be laid down in the half-breadth plan, just in the same manner as that in which the main rail was laid down, to which lines the moulds for each of them must be made.

The bevelling for the after head-timber may next be taken, by proceeding in the following manner: set off the siding of the timber in the sheer-plan, draw the foreside, and square the foreside down to the middle line in the half-breadth plan; then, from where the aftside of the timber in the sheer-plan intersects the upperside of the upper cheek, square a line to intersect the foreside of the timber, which line may be termed the base line in the sheer-plan, as it agrees with the base line of the aftside of the timber laid down in the plan of the timbers. Take the height from the base line in the sheer-plan, up the foreside of the timber, to the upper and lower sides of the rails, and set them up from the base line in the plan of the after head-timber, striking horizontal lines; then, where the foreside of the after head-timber in the half-breadth plan intersects the chamfered line of each rail, take the distances square to the middle line, and set them off from the middle line in the plan of the after head-timber on their corresponding lower horizontal lines. A curve drawn through the several spots so set off will shew the exact form of the foreside of the after head-timbers; then, at whatever distance the foreside is from the aftside on a square, so much is the bevelling of the timber under from a square in the siding of it. The bevelling for the heel of the timber may be taken by applying the stock of a bevel to the aftside of the timber, and the tongue to the flight of the upper part of the cheek.

The foreside of the timber may be completed in the plan, in all respects, as the aft-side, by taking the size of the cheek, the half-thickness of the knee, and the height of the cutting-down, as for the aft-side.

The thwartship sections of the rails are laid down for the fore-side just in the same manner as for the aft-side.

The other head-timbers may now be laid off and bevelled in the same manner; and, although they may be raked forward, to give a light appearance to the head, where they intersect the rails in the sheer-plan, is squared down to their corresponding outside straight lines in the half-breadth plan, and their half-breadth taken square from the middle line and applied as before; and, in the sheer-plan, their respective heights are taken from the base line, agreeably to the rake of the timber, and set off above the base line in the plan of the timbers, as may be seen in Plate 7.

The explanation of laying down the foremost head-timbers is only pointing out what may be done on the floor, and that with great exactness, when performed carefully; but, were the timbers trimmed, and the scores taken out from the lines on the floor, the timbers could not be altered afterwards. The customary method is, therefore, to set the head rails to the after-timber upon the ship, and place the foremost timbers so as to please the eye.

The moulds for the head-rails may be made in the sheer-plan with much less trouble and more dispatch, thus: where all the perpendicular lines intersect the upperside of the rails in the sheer-plan, draw horizontal lines aft; then obtain the outside line only to the spread of each rail in the half-breadth plan, as before directed, and fix a batten, with one end well with the perpendicular as squared down from the fore end of the rail: upon the batten mark all the intersections of the other perpendiculars, and after end of the rail as squared down from the sheer-plan, the batten being kept well to the said outside line in the half-breadth plan; then set off each spot on the batten, upon its corresponding horizontal line in the sheer-plan, keeping the same end of the batten fitted well with the perpendicular at the fore end of the rail; a curve drawn through those spots will give the upperside of the rail to the spread exactly the same as that in the half-breadth plan; and then a batten, pinned round to the upperside of the rail, having the spots as set off on the horizontal lines marked thereon, may thence be laid against some straight line as at u, and the rail regularly diminished to its moulded size as before described. Thus may all the moulds be made, agreeably to the uppersides, as shewn in the sheer-plan in Plate 7.

The knee of the head comes next under consideration; the mould for which is made of fir board, about four inches broad, to the lines already laid down, which are exactly conformable to those in the sheer-draught; therefore, all that is now required is, to find proper sections at certain places in order to side it, which sections are generally described on the mould by the battens or braces that hold the mould together, and the knee is supposed to be trimmed exactly conformable, on each side, to the size of those battens in that direction, and at the heights of their uppersides. Let fall a perpendicular from the foreside of the knee of the head to the middle line of the half-breadth plan, where the half-thickness of the knee is already set off, as it is intended to be at the cutting-down or upperside of the knee; and it will represent the half siding of the knee from the lowerside of the lower cheek upwards, agreeably to any perpendicular lines: then, from the lowerside of the lower cheek, and foreside of the figure, the knee is bearded in the following manner: draw the lines across the knee, where the upperside of the battens or braces are intended to be, as 1, 2, 3, 4, 5, 6, and 7, letting them be as nearly square as possible from the foreside of the knee; and, where those lines intersect the upperside of the knee, square them down to the lines first drawn for the half siding of the knee in the half-breadth plan; at which places, take the distance between the two lines, and set them off at the intersecting of their corresponding lines at the upperside of the knee, and square from the lines, and it will give the half siding of the knee at those places; also, where the lines on the knee intersect the lowerside of the lower cheek, and foreside of the figure, square down to the half-breadth plan, as before at line 2, to the half siding of the knee; then take the half sidings at those places, and set them off at the corresponding places whence they were squared down, which will give the half siding of the knee at each place: now set off the half siding of the knee at the fore part of the rabbet, at the stem, by taking the heights of each line, and transferring them to the middle line in the fore-body plan: then take off the half thickness of the stem at each height, and set it off square from its corresponding line on the knee at the foreside of the rabbet; next determine on the half siding of the knee at the fore-part at the lower end, and pin a batten from the upper part of the knee round the foreside, marking the lines 1, 2, 3, 4, 5, 6, and 7, and lower end, on the batten; then fix the upper end of the batten well with the upper part of the perpendicular at the foreside of the knee, and mark on the said perpendicular all the lines as taken off from the foreside of the knee. Again, set off the half siding of the knee at the upper part of the perpendicular, and likewise the half of what was determined at the lower part, as taken from the foreside of the knee, and strike a straight line from those two spots at the foreside of the perpendicular; which will be the half siding of the fore-part of the knee: then take off the half siding at each line which was taken from the knee, and set them off square from their corresponding lines at the fore-part of the knee, which will give the half siding of the foreside of the knee at each line: from these spots to the spots at the lowerside of the lower cheek and foreside of the figure, and thence to the upperside of the knee and to those at the foreside of the rabbet of the stem, strike straight lines, which will give the siding of the knee at any part, being the half-thickness of the knee at those places; so that, by nailing the battens on the mould agreeably to the two lines, we ascertain what the half thickness of the knee should be at the upperside of the battens, and in that direction.

The mould for the Gripe is made so similar to that for the Knee as to require no farther description.

The Cheeks must have a mould made to their flight, as the cheeks are represented in the sheer-plan, and another mould to their shape shewn in the half-breadth plan; then, when moulded, the flight-mould must be fastened to the arm of the cheek, next the knee of the head, and the cheek trimmed out of winding by thwartship lines, or lines square from the mould; thus we shall be certain that, when the cheek is throated, there will be no angle in the throat, as there is sometimes, by the usual method in full-bowed ships, wherein the sheer springs very much.

Another method to side the cheeks is, to mark the sheer of the wale upon the flight-mould to its fore end; then, when the knee-arm is drawn off to the cheek-mould, let the flight-mould be tacked thereto, proving first that the piece will side to the flight. This is best done on a saw-pit, the knee-arm standing upright. Then get in the sheer-line, the same as on the flight-mould upon the inside or throat of the piece, and then the flight may be gotten upon the throat by spilings from the sheer-line, and both sides of the piece be lined throughout to the flight. When the piece is sawed thereto it may be moulded, and finished by the saw, to a great nicety.

§ 18. OF LAYING DOWN THE SEVERAL PARTS OF THE STERN. *(Plate 7.)*

First, the stern-timber must be laid off, and a mould made to it, so that when put up in its place on the ship, and kept to its tumbling home of the side, it should appear as the ticked line on the sheer-draught.

The ticked line in the sheer-draught represents the stern-timber as it appears on the ship when viewed in a horizontal direction, and must be taken off from the sheer-draught and represented in the same manner on the floor. Now proceed, as follows, to represent it in the body-plan. Strike several horizontal lines across the stern-timber in the sheer-plan, one at the upper-side of the wing-transom at the side, one at the knuckle of the lower counter and upper counter, one or two between the upper counter and top-breadth, and, likewise, two or three between the knuckle of the lower counter and wing-transom, as it will be rather more difficult to obtain the exact shape of that part than of the others: transfer these horizontal lines, and strike them across the after body-plan; then take off the half-breadth of each horizontal line in the body-plan, at every square timber, and set them off on their corresponding square timbers from the middle line in the half-breadth plan, and run their curves as in Plate 3.

Then, where the horizontal lines in the sheer-plan intersect the ticked aftside of the stern-timber, square them down to their corresponding horizontal lines in the half-breadth plan, taking their distances square from the middle line of the half-breadth plan, and setting them off from the middle line on their corresponding horizontal lines in the after body-plan; a curve passing through these spots will shew the thwartship form of the aftside of the stern-timber, agreeable to the lines of the sheer-plan; but, if these spots should not make a fair line in the body-plan, those in the half-breadth plan must be altered, which seem most to require it, in order to make them correspond and make a fair line in the body-plan.

In the next place, represent the ticked foreside of the stern-timber in the sheer-plan, (taking its moulded size from the table of dimensions;) and, where it intersects the horizontal lines square it down to their corresponding horizontal lines in the half-breadth plan, and take their distances square from the middle line of the half-breadth plan, setting them off from the middle line on their corresponding horizontal lines in the after body-plan; a curve drawn through these spots will represent the foreside of the stern-timber in the after body-plan.

Strike a straight line in the after body-plan from the horizontal line of the wing-transom at the side, to the upper part of the stern-timber; let it be as near to the line representing the foreside of the timber as only to allow for the thickness of the mould; then place a batten to this line, keeping the lower end of the batten well with the horizontal line of the wing-transom at the side; and mark on the batten, as it lies, all the other horizontal lines: then take the batten to the sheer-plan, and place it perpendicularly to square timber 38, keeping the same end fitted well with the horizontal line of the wing-transom at the side, and set up the heights of all the horizontal lines; then strike new horizontal lines, that is, according to the falling home of the timber. Now, where the horizontal lines first struck in the sheer-plan intersect the aft-side and foreside of the stern-timber, square them up to their corresponding new horizontal lines, through which spots new lines must pass in order to get the true shape to which the mould of the stern-timber must be made. The last heights which were set up are the proper heights of the knuckles and horizontal lines to be marked on the mould.

The lines last shewn in the sheer-plan, to which the mould is to be made, are supposed to be the straight line in the body-plan, standing fast at the wing-transom, and the head lifted up till it stands perpendicular; which, if lowered again to the direction of the said straight line in the body-plan, will appear exactly the same as the stern-timber first represented in the sheer-plan, which is the form of the timber required when trimmed and in its place.

In the next place, the mould must be marked, and in such a manner that the stern-timber shall be trimmed both ways by this one mould; that is, to the shape as it appears in the sheer-plan, and likewise to the foreside and aftside thwartship appearance in the body-plan.

Now proceed in the following manner: lay the mould in its place, to the lines it was made to in the sheer-plan, and mark on it the new horizontal line, in the same direction as they are laid down, distinguishing them by their proper names on the mould, as the lower counter, upper counter, &c.; then take the distances from the straight line in the body-plan to the foreside of the stern-timber at every horizontal line; and, in the direction of the horizontal lines, set them down in figures on their corresponding horizontal lines on the foreside of the mould; then proceed, in the same manner, and set down the distances or spilings on the aftside of the mould as represented in Plate 3.

Then, to mould the timber, the general method has been to lay the mould upon the piece and lift the lower end, till the mould, as it lies upon it, answers the same tumbling-home as the straight line in the body-plan; and, likewise, in the direction of the horizontal lines. The mould must lie horizontally, and then every spiling marked on it may be set down from the mould to the timber in a perpendicular direction, which will give the exact stations of the knuckles, &c. and, likewise, the exact shape of the timber at the foreside and aftside, agreeably to the lines in the body-plan; but, if the timber be broader than the mould (as it undoubtedly will be in its rough state), a straight batten must be applied on the mould, in the direction of the horizontal lines; for instance, the spiling down from the mould at the upper counter is thirteen inches and a half at the foreside, and seventeen inches and a half at the aftside; the difference is four inches; therefore, lift up the batten on the foreside four inches upon a perpendicular, and close down to the mould at the aftside, and then the spiling will be seventeen inches and a half, parallel to the batten upon a perpendicular, let the rough timber be as broad as it may.

This method of lifting up the lower end of the timber, in order to mould it, is not only attended with much trouble, but also with danger, before it can be gotten into its proper position. We would not, therefore, recommend it for practice, as the timber can be moulded equally as true and exact without it, in the following manner: let the timber lie flat, or in any situation, lay the mould upon it, and just try the spilings in a rough manner, in order to get the mould nearly in its right position; the spilings cannot yet be set off to a nicety, because they must not now be set off perpendicularly, for the timber lying flat, and the horizontal lines in the body-plan not being square from it, it consequently follows that, if the spilings were set off perpendicularly, the stations of the knuckles, &c. would be too low; the timber would thus have too much wood taken away, and the shape of it would be quite altered: therefore, as the spilings are not to be set off perpendicularly, we must find in what direction they are to be set off: apply the stock of a bevel (the broader the stock is the better) to the straight line in the body-plan, and fix the tongue to the horizontal lines, which, if the stock is placed upwards as in Plate 3, at top breadth, the bevelling will be an under bevelling; now, to apply the bevel upon the mould, it must be reversed, but placing its stock upwards as taken, will give the direction in which every spiling is to be set off at the fore and after sides of the timber; and this will give the stations of the knuckles, &c. and the shape of the timber as true as when the great trouble is taken to lift the lower end of the timber up, in order to get its right position.

In the foregoing method of making the mould, and also of applying it in moulding the piece afterwards, much nicety and pains are required in plumbing down the sides and setting off the spilings; and, in the second method, by the bevel, the tongue sideways must be kept exactly square from the mould, though in this respect a bracket may be made to this bevelling, the bottom of which might lie flat on the mould, and the side which gives the direction of the horizontal lines by that means kept square from the mould; and observe, in every position, that the mould must be supported straight and out of winding: it is very evident, therefore, that, without much care, the stern-timber will not be exactly moulded.

The most correct method of making the mould, and the easiest in application when moulding the piece, is, to have a mould made as first described; and, instead of having the spilings marked on the mould, to have brackets of thin deal made agreeably to the spilings (deducting the thickness of the mould) at each horizontal line, having their ends at the fore and after sides cut off exactly square from the mould. Then fasten those brackets to the underside of the mould, keeping the middle of their thickness exactly well with their respective horizontal lines, and their sides in the same direction from the mould as the horizontal lines are from the straight line in the body plan. Or, in other words, to the inclination which the straight line has from a horizontal plane in representing the tumbling home of the stern-timbers.

To be as exact as possible, let the half-thickness of the brackets be gauged down to their ends, and the sides chamfered away, which will direct upon the timber, when trimmed, the exact stations of the knuckles, and, also, of the horizontal lines. By the former methods, the foreside, as well as the aftside, of the stern-timber, was required to be laid down in the body plan; but, by this method, the aftside only will suffice; for the brackets may be made from the half breadth plan thus: Take the distance from the straight line in the body plan to the aftside of the stem timber, in the direction of the horizontal lines, say at lower counter, and set it off from its respective half-breadth line up the perpendicular line ticked down at its aftside; thence draw a horizontal line, to touch the line squared down at the foreside upon the same half-breadth line, and we shall have the bracket as then represented, which will be found to agree with the bracket represented at its corresponding line in the sheer-plan, as formed from the spilings on the mould. (Observe, that the thickness of the mould must be taken from the bracket, as the line whence the spilings are taken in the body plan represents the upper side of the mould.) Proceed in the same way with horizontal line 4, and you will find it to agree with its corresponding bracket in the sheer-plan and so with the others, as more will only confuse the draught. This mould may be applied in any direction in moulding the timber, keeping its upper side straight and out of winding. Then examine where the piece in its rough state deviates most from the brackets on the mould, and make that a general spiling to be applied from the under sides of the brackets.

Wherever this spiling must be applied on the outside of the brackets, owing to the inequality of the piece, let a straight edged batten, of sufficient length, be fitted well to the under side of the bracket, from which set down the spiling required wherever it may touch the piece. Then, by boring holes, with a small gimblet, full as much below the brackets as the general spiling, and keeping the gimblet exactly in the direction of the gauge line at the ends of the brackets, you will preserve the exact moulding after the rough wood is sawn off, and the true place of the mould readily formed.

Now, to take the bevellings of the aftside of the stern-timber, the round aft of the stern, at the counters, wing-transom, and toptimber line, must be thus laid off in the half-breadth plan. Take the distance between the ticked lines representing the stern at the side and middle line, on a square, in the sheer-draught, and set that distance off upon the middle line of the half-breadth plan abaft its corresponding perpendicular as squared down from the counters, &c. at the side; sweeping curves that shall intersect the half-breadth of the stern at the perpendicular and spot set off abaft it at the middle line of the half-breadth plan; then fix the tongue of a bevel to the different round aft lines and the stock parallel to the middle line as at the upper counter half-breadth plan (Plate 3), which will give the bevelling at each respective place to be applied square from the mould.

Or the bevellings may be taken and applied square upon the outside of the timber, when properly trimmed, by running a half-breadth section square from the rake of the stern-timber thus, strike a line square from the rake of the stern-timber to intersect the knuckle of the upper counter in the sheer-plan; and, where the square timbers 34, 35, 36, 37, and 38, intersect this squared line, in the sheer-plan, square out lines and transfer their heights to their corresponding square timbers in the after body plan, then take off the half-breadths at those heights in the body plan, square from the middle line, and set them off upon their corresponding timbers, last squared out from the middle line of the section in the sheer plan; a curve being drawn to pass through these spots will give a half-breadth section square from the aft-side of the stern-timber at the upper counter. Then square down the touch of the upper counter and sweep its round aft upon a square as before; then fix the tongue of a bevel to the round-aft line and the stock to the half-breadth line of the section as in the sheer-plan Plate 3, and that will be the bevelling to be applied upon the outside, square from the timber when trimmed. Set off the half-breadth of the stern at the topside line, on the round aft-line, square from the middle line of the section in the sheer-plan; and the difference of the round aft at the topside, and at upper counter in the siding of the timber, will shew how much the aft-side of the timber will require to wind: or, another section may be run at the topside, as before, and the bevelling taken: then the aft-side, at the upper counter, being bevelled between the knuckles of the lower and upper counters, may be trimmed out of winding to that bevelling, and the lower counter to wind gradually thence to the wing-transom. To take the bevellings, to give the round up of the knuckles, fix the stock of the bevel against the line representing the aftside of the stern-timbers in the body plan, and the tongue to the round up lines as at the upper counter Plate 3, and so apply them against the aftside of the timber where the outside is trimmed.

The bevelling to cut off the heel is taken from the body plan thus: fix the stock of the bevel to the straight line in the body plan, and the tongue to the round up of the wing-transom as in the body-plan, Plate 3. Then, to apply this bevelling, observe that the heel of the mould is made to where the straight line and round-down of the wing-transom intersect, so that, when the mould lies in its proper place, upon the piece, this bevelling is applied over the heel as taken, and when the heel is cut off thereto, a thin mould made to the heel of the timber, as shewn in the half-breadth plan, Plate 3, and so applied upon the heel of the timber, the heel may be trimmed to fay against the fashion piece and aftside of the wing-transom.

To prove the bevellings, as directed to be taken for the aftside of the timber, take the bevelling, as represented, from the horizontal line in the half-breadth at the upper counter, and place the stock well with the horizontal line, and the tongue against the aftside of the bracket at the upper counter, as in the sheer-plan Plate 3, and you have the bevelling of the aftside of the timber at that place as shewn by the solid section. Now, it is evident, from the plate, that the bevel applied this way from the mould will touch the mould before it touches the outside edge of the timber; consequently, that mark or spiling must be applied parallel from the tongue of the bevel. Again, take off the bracket, as ticked at the upper counter, in the half-breadth plan, which is laid off from the half-breadth section run square from the aftside of the timber in the sheer-plan, and there represented by the short ticked line; by setting off this bracket above its corresponding horizontal line at the stern-timber in the sheer-plan, we shall have the short ticked line there shewn, which gives the side of the timber (supposing that the bracket stood square); then take the bevel, shewn at the half-breadth of the section in the sheer-plan, and lay the stock well with the ticked line of the bracket at the upper counter in the sheer-plan, with the tongue to touch the after edge of the bracket; that bevelling will agree with the aftside of the solid section, as set off before, and so on with the bevellings at the other places. The foreside of the timber may be sawed to follow the bevellings of the aftside, or to look athwartships when in its place.

As some persons may wish to be acquainted with quicker methods of trimming the outside of this timber, (although the artist cannot be too nice, especially when a plan of the stern is given and the heights of the knuckles, &c. must be exactly conformable thereto,) let a mould be made to the sheer-plan, as before described, and mark upon it the horizontal lines 3, lower and upper counter 4, topbreadth, topside, and after proof timber at the heel, which is all we shall want on it for this purpose; then make a toptimber mould to the after proof timber, by continuing it upwards to the top of the side in the body plan, by taking its intersections at the horizontal half-breadth lines square from the middle line of the half-breadth plan, and setting them off upon its corresponding horizontal lines. From the middle line in the body plan to the curve passing through these spots let a mould be made, similar to that at the left hand of the after body in Plate 3. The lower end of the toptimber mould will fay from the heel of the stern-timber as high as horizontal line 2, made as in the plate. For that purpose, mark on the toptimber mould, the upper side of the wing-transom at the line of the aftside, then mark horizontal line 3, upper and lower counter 4, topbreadth, and topside. Then provide a thin board, about nine inches broad, whose straight edge may be laid to the horizontal half-breadth line at the topbreadth, and a sirmark marked on it, at the aftside of the stern-timber and intersection of the after proof timber, as it lies in its place, in the half-breadth plan; and, upon it mark the different windings of the half-breadth lines at upper and lower counter and horizontal line 3, as represented in the plate under the half-breadth plan, by placing the edge of the board to the half-breadth at top-timber line, and then marking the different half-breadths thereon. Now, to mould the timber, lay the mould made to the stern-timber in the sheer-plan upon the piece, so as to see that it will mould; then cut off the heel to the lower end of the mould and heel bevelling as before described. Next trim the heel of the piece to the toptimber mould, as high up as it will fay, keeping the mould at the toptimber line its distance from the aftside of the timber. Trim a spot through, in the direction of the winding board, at the toptimber line, the sirmark on the heel of the top-timber mould and the angle at the aftside of the heel of the stern-timber must at the same time be kept exactly together; then, with a long straight edged batten, laid well at the different heights, as marked on the stern and top timber moulds, and fixed out of winding with its corresponding line marked on the *winding board*, spile down spots on each side of the timber parallel with the said batten; the rough wood may then be sawn or trimmed straight through to lines got in upon the timbers to those spots, and the inside part of the timber may be got in to the thicknesses corresponding, or moulding of the after frames. Then, when sawn, the timber may be moulded, the knuckles of the counters teached down fair, and the aftside bevelled as before directed.

Now, in order TO LAY DOWN THE STERN, &c. and make the moulds for that part of the ship, it will be necessary to lay down the stern to its rake, and round-aft; but, before that can be done, the stern must be laid down to its horizontal appearance as follows.

The line C D Fig. 1 in Plate 7, is an horizontal line at the upper edge of the wing-transom, at the middle line, and may represent the upper edge of the rabbet of the keel, or line A B in the mould-loft, at some clear place; for we are not to suppose any mould-loft broad enough to admit the stern to be laid down in its proper situation.

Lay off the midship and side stern-timbers, from the sheer-draught, and the quarter view as far forward as square timber 36, from a horizontal line drawn in the sheer-draught at the height of the wing-transom at the middle line. Continue aft, as in Plate 7, Fig. 1, a horizontal line from the height of the knuckles of the upper and lower counters, at the side timber in the quarter or sheer-plan, and set off the half-breadths of the stern-timber on each side of the middle line in the plan of the stern upon its respective heights from its aftside appearance in Plate 3; then set off the scantling of the timber and describe the inside of the stern-timber.

The stern-timbers being shewn in the horizontal plan of the stern, take the heights from the line C D in Plate 7, in the sheer-plan, to the knuckle of the lower and upper counters at the midship timber, and set them up the middle line above the line C D in the horizontal plan of the stern. Then sweep curves to intersect the height at the middle line; and, at the half-breadth of the timber on the horizontal lines; and they will represent the knuckles of all the counter timbers in the horizontal plan of the stern.

Proceed now to lay down the upper and lower counter rails, in the plan of the stern, thus: at the knuckle of the upper and lower counter of the midship timber, in the sheer-plan, square aft a line from its respective counter as a, b; then, from the knuckle on the square line set off the thickness of the counter plank, and take that height at its respective counter on a perpendicular from the line C D; then transfer them up the middle line, from the line C D in the horizontal plan of the stern; and, above those heights, set up the moulding or depth of the rails and sweep curves to intersect those spots, parallel to the ticked curve, or knuckles of the timbers sweeping them far enough beyond the timbers for the outside of the gallery.

Then take the height of the underside of the quarter deck at the midship stern-timber in the sheer-plan, above the line C D on a perpendicular, and set it up the middle line above the line C D in the horizontal plan of the stern; next take that height from the upperside of the upper counter rail, and set it off above the upper side of the upper counter rail at, and in the direction of, the side stern-timbers, in the horizontal plan of the stern; now sweep a curve which shall intersect those spots, and this will give an agreeable round-up to the quarter deck transom. (The after beams of the quarter deck must be gradually sprung to answer thereto.) Sweep another curve, parallel to the quarter deck, to represent the under side of the transom; and another at least one inch and a quarter below it, to allow for the joiner's roofing, and that may be the upper part of the lights.

Set off, withinside the stern-timbers in the horizontal plan of the stern, the thickness of the quarter deck clamps and projection of the cornice under the beams in the cabin, and that shall be the side of the lights next the side. Then determine on the breadth of the munions, which may be about sixteen inches, upon the upper counter rail, and divide them across the stern so as to make six equal lights between the side stern-timbers. Next, continue upwards the middle line in the plan of the stern, and the side stern-timbers above the upper counter rail till each unite in one centre at the middle line, and call it the center of the stern; then fix a line, or batten, to that centre, and strike down all the sides of the munions as set off upon the upper side of the upper counter rail. On each side of the munions about one inch and a quarter will now represent the width of the sashes in the clear.

In order to have a well proportioned depth to the sashes, take the width in the clear at bottom, and set it up the side, and take the hypothenuse or distance from the width set up to the width at the bottom on the opposite side, and set it off up the rake of the stern-timber, in the sheer-plan, which gives the depth of the lights in the clear: then take that height upon a perpendicular from the line C D and set it off above the line C D in the plan of the stern, and sweep a parallel curve to the under side of the quarter deck transom.

Now, it is very evident, that, owing to the tumble home of the side stern-timbers, the munions and appearance of the sashes in the clear will be narrower at the upper part than at the bottom, but the outsides of the sashes must be of a parallel breadth or they cannot slide; therefore the side stiles will not be parallel, but broadest at top, which is hidden by the munions when the sashes are in their places.

It may, however, be observed that, in sterns of frigates, or when the sashes slide upwards, rabbets must be taken out of the aftsides of the counter timbers to make room for the pully pieces and pullies. Springs would wound the timbers less, but cannot be recommended because so liable to be out of order.

Set off the mock light in the aft part of the quarter gallery, of the same size as the other lights; and, at about half the breadth of the munions from the mock light, fix the inside of the quarter piece; then set off the breadth of the quarter piece at the heel, the outside of which determines the outer ends of the upper counter rail in the plan of the stern: next represent the chamfer necessary for the mouldings on the outer ends of the rails; and, within that, at the under edge, set off the thickness of the birthing of the quarters, which will give the knuckles of the quarter timbers at the outside of the gallery; then strike a straight line, from the knuckle under the upper counter rail to the outside stuff at the wing-transom, and that will give the knuckle at the outside of the quarter at the lower counter rail and rail also, as shewn in the plan of the stern.

Having represented the lower and upper counter rails in the horizontal plan of the stern, let them likewise be represented in the sheer-plan as follows: drop perpendiculars from the knuckles of the upper and lower counter of the midship stern-timber, in the sheer-plan, as c d, to intersect the horizontal lines at the knuckles of the side stern-timber; likewise drop perpendiculars from the knuckles of the side stern-timber in the horizontal plan of the stern, as e e, f f, and take the distances in the sheer-plan from the knuckles of the side stern-timber to the intersection of the perpendiculars c, d, at the horizontal line a m, set them off from their respective knuckles at the side stern-timber, in the horizontal plan of the stern, down their respective perpendiculars e e, f f, then sweep the curves that shall intersect the spots at the side and horizontal line, at the middle line, and they will shew what the stern rounds forward on a horizontal view, and the horizontal lines at the upper and lower counters will be found to answer to the perpendiculars c, d, which drop from the knuckles of the midship timber in the sheer-plan. Take the heights from the line C D in the horizontal plan of the stern, to the knuckles at each counter, at the outside of the gallery on a perpendicular, and set them off from the line C D in the sheer-plan, striking there an horizontal line under their respective knuckles, as g, h ; then, from the horizontal lines on the horizontal plan of the stern, drop perpendiculars to intersect the knuckles of the timbers at the outside of the gallery down to the horizontal round-forward curves, as i, i, k k; and take the distance from the horizontal lines to the horizontal round-forward curve on the perpendiculars i, k, in the horizontal plan of the stern, and set it forward from the perpendicular c, or d, at their respective knuckles on the horizontal line g or h; which gives the exact knuckles at the outside of the gallery timbers in the sheer-plan. Then strike a straight line, to intersect the upper and lower counter knuckles of the midship and side timbers, to the spots set off for the knuckle outside of the gallery, in the sheer-plan; and, from the upper to the lower counter knuckle at the outside of the gallery make a curve to the hollow designed for the upper counter; and, a parallel curve outside of that, to the thickness of the birthing. Now take the heights of the ends of each counter rail upon a perpendicular from the line C D in the horizontal plan of the stern, and set them off in the sheer-plan at the knuckles, outside of the galleries, and continue them forward by straight lines agreeably to the sheer of the ship; which will be the exact heights at which the lower and upper counter rails should appear on the ship.

Before the middle stool can be determined upon, in the sheer-plan, the true situation of the foot-space rail must be described. Let the line A B represent the middle line of the half-breadth plan, and take, from Plate 3, the half-breadth of the quarter deck as far forward as square timber 36, setting it off from the middle line as in Fig. 1, of Plate 7. Then drop a perpendicular from the intersection of the side line of the quarter deck with the side timber, down to the line A B, and square down a spot upon the line A B from where the under side of the quarter deck, at the middle line, shall intersect the midship stern-timber; then, from the middle line A B sweep an arch that shall intersect the spot last squared down on the middle line and half-breadth of the quarter deck at the side, which curve may be continued to the outside of the galleries. Set off the scantling of the side stern-timber at the quarter deck, within the half-breadth line, and continue it eleven inches abaft the curve last swept, for the convenience of the upper gallery, and four inches abaft that to allow for the balusters which will be the aftside of the quarter deck at the side, and thence must be continued out, and parallel to the curve last swept. Then, from the plan of the stern, take the half-breadth or outside of the middle stool and set it off square from the line A B upon the aftside line of the quarter deck, which will determine the outside and aftside of the middle stool in the half-breadth plan.

Draw a curve in the half-breadth plan that shall be the boundary line for the after ends of the quarter deck, and to shew the round-up of the ends of the quarter deck in the sheer-plan. Agreeably to that curve, strike the lines marked 1, 2, 3, &c. parallel to the middle line A B in the half-breadth plan; and, where they intersect the boundary line, square them up to the under side of the quarter deck at the middle line in the sheer-plan. Then drop the perpendicular E F, abaft the balcony, at pleasure; continue aft to this perpendicular, a line, parallel to the middle line A B, where the aftside of the quarter deck intersects the half-breadth at the outside. This line is 7. Now take the round up of the quarter deck, upon a perpendicular at the side-timber, in the sheer-plan, and set it off from the perpendicular E F upon the line 7; and, from the middle line A B sweep an arch to intersect the perpendicular E F at the middle line A B. The spot on line 7 and that curve is the round up of the quarter deck upon a perpendicular; and where the horizontal lines 1, 2, 3, &c. intersect the perpendicular E F, take the distance to the curve or round up of the quarter deck, and set them off below the under side of the quarter deck at the middle line on their respective perpendicular lines; a serpentine line passing through those spots will represent the round-up of the ends of the quarter deck in the sheer-plan; then, another line, parallel to this, about one inch and a quarter below it, represents the under side of the foot-space rail. Now, where the ticked line or under side of the quarter deck intersects the outside of the middle stool as at line 10, strike a line parallel to the lower rim-rail, as the ticked line, and that line will be the under side of the middle stool in the sheer-plan. Again, strike lines parallel to the last where the upper and under side of the foot-space rail intersects at the outside also, and the rail will be shewn in the sheer-plan. The foot-space rail may now be shewn in the horizontal plan of the stern, thus; take off the horizontal lines 1, 2, 3, &c. from the middle line in the half-breadth plan, and set them off from the middle line in the horizontal plan of the stern, striking perpendiculars at each spot, and marking them with the corresponding numbers of 1, 2, 3, &c. then take the heights of the under side of the quarter deck at each perpendicular in the sheer-plan, above the line C D, and set them up upon their corresponding perpendiculars above the line C D in the horizontal plan of the stern; a curve drawn through these spots will form the ticked line, or under side of the quarter deck, at the balcony in the horizontal plan of the stern: and, a parallel line, three inches above it, will shew the thickness of the quarter deck. The foot-space rail will next be represented by two lines; one parallel to, and an inch and a quarter below, the under side of the deck, and another above that to the depth of the rail, and thence transferred to the sheer-plan.

The breast rail may be next laid off, in a similar manner, as its alteration is only in consequence of the tumble home of the side stern-timber; to point out the difference, strike lines from the centre of the stern to intersect each perpendicular on the larboard side, at the under side of the quarter deck, continuing them thence as high as you intend the upper side of the breast-rail to be above the quarter deck in the horizontal plan of the stern; which height must be set up at the middle line and upon the lines 1, 2, 3, &c. agreeably to their rake or tumbling home, as then the balusters will be all of one length. A curve line passing through the several heights forms the upper side of the breast-rail; and, another curve line, parallel to it, at the depth of the rail on the under side. Then, where the perpendiculars 1, 2, 3, &c. in the sheer-plan intersect the round-up of the under side of the quarter deck, strike lines parallel to the side stern-timber as there ticked; then take the several heights of the upper and under sides of the breast-rail, perpendicularly above the line C D, in the horizontal plan of the stern, at the divisions marked 1, 2, 3, &c. on the larboard side, and set them off, in the same manner, above the line C D upon their respective divisions in the sheer-plan. Serpentine lines drawn through those spots will form the breast-rail in the sheer-plan. Now square down to the half-breadth plan, perpendiculars from the intersections of the several divisions 1, 2, 3, &c. at the upper side of the breast-rail in the sheer-plan, and take the half-breadth of the divisions 1, 2, 3, &c. in the horizontal plan of the stern where they intersect the upper side of the breast-rail, setting them off from the middle line in the half-breadth plan, upon their corresponding divisions squared down. A curve line passing through the several half-breadths is the line to which the mould is to be made for moulding the breast-rail; and a mould made to the curved line next afore it, is the mould by which the ends of the quarter deck may be cut off. Now it must be observed, that, whatever substance is required abaft the balusters, for the projection of the mouldings, must be allowed for abaft these moulds, as they were laid down well to the aftside of the balusters, upon the moulds must be marked the middle line and the half-breadth line also, or the division line 7.

Let the contour, or outside figure, of the stern, above the counter rails, be next represented upon the floor in the plan of the stern from the sheer-draught. Or, determine on the round-house transom, in the same manner as that of the quarter deck; and, above the upperside of the transom, set up about four feet, at the middle line, for the upperside of the taffarel: then take the height of the upperside of the plank-sheer, in the sheer-plan, at the side-timber, and set it off above the line C D at the side-timbers, in the plan of the stern. Determine on the breadth of the upper stool, by continuing upwards the birthing of the upper gallery; then, from the middle line to the heels of the quarter pieces form curves, agreeably to fancy, to the heights set off, and breadths of the upper stool and rails below it, and the out boundary of the stern will be represented in the horizontal plan of the stern.

Proceed to lay off the taffarel and quarter pieces in the sheer-plan thus: square up the perpendiculars 1, 2, 3, &c. on the larboard side, in the horizontal plan of the stern, to intersect the boundary line of the taffarel and quarter pieces; then transfer the height of each intersection, and strike horizontal lines across the stern-timbers in the sheer-plan, and number them also, as may be seen in Plate 7. Strike the line l, parallel to, and eleven inches abaft, the side stern-timber from the quarter deck, to the top of the side in the sheer-plan; which is the aftside of the side stern-timber. Then, to represent the aftside of the midship stern-timber, square down on the larboard side of the half-breadth of the stern, at the quarter deck, and at the topside, to the ticked horizontal line at the upper counter marked n, o, in the horizontal plan of the stern. Next take the round forward at n, and set it off abaft the line l or aftside of the side stern-timber, at the top of the side, in the sheer-plan; do the same also at o, and set it off likewise at the quarter deck; then strike the line m in the sheer-plan, which is the aftside of the midship stern-timber. Now take the round forward, at the several perpendiculars, from the horizontal line at the upper counter in the horizontal plan of the stern; and set them forward from the line m, in the sheer-plan, on their corresponding horizontal lines. Then pin a batten to those spots, which produces the curve line p, the upper part of which represents the foreside of the taffarel and the ticked part of the aftside of the stern-timbers, supposing them continued to the outside of the quarter piece. The line m represents the foreside of the taffarel at the middle line, and the line r, which is the thickness of the taffarel parallel abaft m, is the aftside of the taffarel at the middle line. A line from the upperside of the taffarel, continued down to the heel of the quarter piece, the thickness of the taffarel parallel to, and abaft, the aftside of the timbers, or line p, is the aftside of the quarter piece; and, the siding of the quarter piece set forward and parallel to the aftside, represents the foreside of the quarter piece also in the sheer-plan.

The quarter galleries may next be laid off, and the rim and stool moulds made thus. Transfer the height of the upperside of the lower rim from the sheer-plan (Plate 7.) to the body plan, (Plate 3.) then take the half-breadths as far forward as square timber 36, and set them off from the line A B in the half-breadth plan upon their respective timbers, as in Fig. 1, Plate 7, and produce the half-breadth line and thickness of the plank without it. Then square down the knuckles of the upper counter from the sheer-plan, and sweep the ticked curve as the foreside of the upper counter rail in the half breadth plan. Next sweep another curve, of the thickness of the upper counter rail, parallel to and abaft the ticked curve, and the upper counter rail will be shewn in the half-breadth plan. Square down the line s, s, from the touch of the upperside of the lower rim in the sheer-plan, and take the half-breadth of the upperside of the upper counter rail to the outside in the horizontal plan of the stern, and set it off from the line A B in the half-breadth plan upon the line last squared down. Thence form the curve line t, or outside of the lower rim, upon which set off the stations of the lights, making them all alike and the munions between. Next square them up to the upperside of the lower rim in the sheer-plan; and, from the spots squared up, strike lines, parallel to the side stern-timber, to the underside of the middle stool. The aft-part of the middle stool is already laid off in the plan of the quarter deck, and the form of the outside may be determined on by the same mould as the lower rim, keeping the fore end well, and allowing the additional length required by the winding of the topside, &c. Then, to prove that the outer edge of the rim and stool are out of winding, square down the sides of the munions from the under side of the middle stool in the sheer-plan to the outside of the middle stool in the half-breadth plan; and, at the aftsides of the munions, marked u, take the half-breadths, and set them off square from the middle line in the plan of the stern upon the underside of the middle stool and upperside of the upper counter rail. Then strike the lines and you will find them all to be parallel, or out of winding. We are, of course, sure that the munions of the quarter lights may all be fixed up out of winding. The upper gallery rim and stools may be laid off in the same manner, and the moulds also made; observing to rake the munions of the upper lights agreeably to those below, which may be set off as follow. Determine on the forepart of the upper gallery, and continue it upwards as the ticked line in the sheer-plan; then, with a batten, fitted as square as possible with the lower munions and one end to the line at w, at the upper side of the lower rim, take off all the sides of the munions. Next, fitting the same end of the batten well to the foreside of the quarter piece, at the upperside of the breast-rail, move the other end of the batten upwards, until the foremost spot intersects the ticked line at the forepart of the upper gallery; and, in that direction, set off all the sides of the munions from the spots on the batten as shewn on the diagonal ticked line; then striking lines through those spots, parallel to the rake of the lower munions, the lights will be represented in the upper gallery.

The upper and lower finishings may be found at pleasure, making them as light as possible, to please the eye, and containing sufficient room in the upper finishing to hold a cistern.

STERN on the RAKE. The horizontal plan of the stern being laid off, proceed to lay off the stern upon the rake; or, at least, the taffrail and quarter-pieces. For, were moulds made to them, as already laid off, it is easy to conceive that they would be too low and too narrow, when fixed upon the stern, to its round-aft and rake; which must be the case upon the ship. On the starboard side, in the horizontal plan of the stern, strike up lines in the middle of each munion; one in the middle of the side stern-timber, at the necking between the taffrail and quarter-piece as timber 4, one up the inside of the quarter-piece, and one between, to teach upwards to the centre of the stern as marked, beginning with the middle line, timbers 1, 2, 3, 4, 5, 6, and outside of the quarter-piece.

Let the line A B, under the horizontal plan of the stern, represent the horizontal line at the knuckles of the side timbers at the upper counter; then, on the left hand of the line A B, as at Fig. 1, strike a line to the rake of the midship and side stern-timber (as it will be clearer on so small a scale, and not confuse the sheer-plan). Then, from the horizontal line at the upper counter, in the horizontal plan of the stern, take the heights square from the said line to where the timbers 1, 2, 3, &c. intersect the ticked curve line (or knuckles of the said timbers), and set them up square from the line A B in Fig. 1. Strike the horizontal lines at each height, as ticked and marked 1, 2, 3, &c. In the same manner take the heights to where the said timbers intersect the upperside of the taffarel and outside of the quarter-pieces, and set them off above the line A B in Fig. 1, striking horizontal lines as ticked and numbered in the plate.

Now the round-up and round-aft of the counter rails, on a square, being required to make the moulds to, and also applicable to our present purpose, proceed to lay off the upper counter rail to the round-aft on a square, which governs all the stern above, and its round-up likewise serves for the basis of the upper part of the stern.

Strike the line x, square from the rake of the midship stern-timber, to intersect at the knuckle of the side timber at the second counter in Fig. 1, as at c, and down to the square line x. Strike the midship stern-timber, and the distance between the midship and side stern-timbers, taken upon the line x, Fig. 1, will be the round-aft of the stern upon a square at the second counter. But, farther, strike the line G H under the horizontal plan of the stern, and square down upon it the half-breadth of the stern at the knuckles of the second counter marked e, e, and outside i, i, and outside of the rail from the horizontal plan of the stern. Then, from the line G H set off at e, e, the round-aft of the stern as taken on the square line x, in Fig. 1, and sweep from the middle line the curve marked the round-aft of the upper counter on a square. From this round-aft proceed to get the rake of the timbers 2, 3, 4, &c. in the sheer, or Fig. 1; thus, where the timbers 1, 2, 3, &c. intersect the ticked curve, or knuckles of the upper counter, in the horizontal plan of the stern, square them down to the round-aft on a square at G H, and number them; then take the round-aft of each timber, square from the line G H, and set them off square from the midship-timber so as to intersect their corresponding horizontal lines in Fig. 1. Then, where the timbers 1, 2, 3, &c. in the horizontal plan of the stern, intersect the upperside of the taffarel and quarter-pieces, square them down to the round-aft of the stern upon a square at G H. Then take their round-aft as before, and set them off square from the midship-timber to intersect their corresponding horizontal lines in Fig. 1; then, from those spots strike lines down to the spots set off at the second counter, and the rake of the intermediate timbers 2, 3, 4, &c. will be represented in their thwartship appearance.

Pin a batten round the curve at G H, marked round-aft of the stern upon a square; and mark upon the batten the stations of the timbers 1, 2, 3, 4, 5, 6, the spots i, i, as squared down from the knuckles at the upper counter, and outside of the quarter-piece or stern: then lay the batten straight along the line A B, keeping the middle line or timbers well with the middle line in the raking-plan of the stern; and mark off the stations of the several timbers outside of the stern, &c. and number them as before.

Although, by the small scale upon which our plans are constructed, the difference is not very visible, yet upon the floor there would be much alteration from the same stations as laid off in the horizontal plan of the stern.

Now, as the square line x, Fig. 1, and the line A B in the raking-plan of the stern, may both be supposed as one base, take the height of the knuckle of the upper counter at the midship-timber square from the line x, Fig. 1, and set it up the middle line above the line A B in the raking-plan of the stern, and sweep the ticked curve which represents the knuckles of the timbers as taken upon a square at the upper counter. Draw the section of the upper counter-rail as represented at the midship-timber Fig. 1, and there take the height of the upperside of the said rail, square above the line x, and set it up the middle line, above the line AB, in the raking-plan of the stern. From that spot sweep a curve, parallel to the ticked curve (or knuckles of the timbers), which is the curve that the upper counter-rail mould should be made to. The underside of the rail may be shewn by taking the depth of the rail upon the rake as in Fig. 1, and set off below the upperside at the middle line in the raking-plan of the stern; then sweep another curve to that depth and parallel to the knuckles, and the upper counter-rail may be said to be laid off in the raking-plan of the stern.

Square up the stations of the timbers 1, 2, 3, &c. from the line A B in the raking-plan of the stern (as before taken from the round-aft of the stern upon a square) to the ticked curve or knuckles of the timbers at the upper counter: then take the height of the upper part of the stern, square from the line x at timber 4, Fig. 1, set it up the middle line above the line A B in the raking-plan of the stern, and strike a horizontal line. Then square down the intersection of timber 4 with the upperside of the taffarel in the horizontal plan of the stern, to the line G H as marked 4 only; then take its breadth upon the round-aft curve line, and set it off from the middle line upon the horizontal line last struck in the raking-plan of the stern, and continue upwards timber 4, on each side, as set off in the raking-plan of the stern, till they intersect at the middle line, which gives the centre by which the intermediate imaginary timbers may be graduated and struck upwards to the upperside of the taffarel, from their divisions on the ticked curve at the knuckles of the upper counter.

Now take the heights square from the line x, in Fig. 1, up each timber, to its corresponding horizontal line for the upper part of the taffarel and quarter-pieces, and set them up square from the line A B in the raking-plan of the stern, to intersect their corresponding timbers. Then, where the circular or upper part of the quarter-piece breaks in with the straight part of the side, make a spot as y, y, in the horizontal plan of the stern. Then square down the said spots to the round-aft of the stern upon a square, to be marked y, y, also. Next take the distance from the middle line to the spots y, y, upon the curve of the said round-aft, and set it off from the middle line upon the line A B in the raking-plan of the stern. Now strike up the perpendiculars y, y, as ticked.

Take the heights of the spots y, y, perpendicularly above the horizontal line at the upper counter in the horizontal plan of the stern, and set them up square from the line AB, Fig. 1; then strike the horizontal lines y, y, and take the distance from the round-aft line to the line GH at y, y, setting it off square from the midship-timber in Fig. 1. on the corresponding horizontal lines y, y, making spots; then take the heights square from the line x, as in Fig. 1, to the spots y, y, last set off, and set them up their corresponding perpendiculars above the line AB in the raking-plan of the stern. The spot for the outside of the quarter-piece, or stern, at the upper counter-rail, is its outer end already described. Now pin a batten round to the spots set off in the raking-plan of the stern, and the true form of the upperside of the taffarel and outside of the quarter-pieces, will be given, agreeably to the rake and round-aft of the stern.

Then take the heights square from the line x, as in Fig. 1, up the several timbers, to the spots set off for the underside of the taffarel and quarter-pieces, and at y, and set them up square from the line AB to intersect their respective timbers in the raking-plan of the stern, which gives the spots for the underside of the taffarel and quarter-pieces; then take off the distance on each side of timber 4 what the square is between the necking of the cove of the taffarel and quarter-pieces, in the horizontal plan of the stern, and set it off at its respective place on each side timber 4 in the raking-plan of the stern. A batten pinned round to those spots gives likewise the underside of the taffarel and inside of the quarter-pieces, to which the moulds must be made. The inside of the quarter-piece mould being cut off to the tumbling-home of the timbers, allow for the scantling of the timber and thickness of the outside plank.

The heel of the mould is cut off to the upperside of the foot-space rail, thus: take the height of the ticked line marked heel upon a perpendicular above the horizontal line at the upper counter, in the horizontal plan of the stern, and set it up square above AB in Fig. 1, to intersect the line for the outside of the quarter-piece; then take that height square up from the line x in Fig. 1, and set it up square from the line CD to intersect the outside of the quarter-piece in the raking-plan of the stern: thence sweep in a line, parallel to the upper counter-rail, which gives the heel of the quarter-piece mould.

The round-up and round-aft, upon a square, of the upper counter-rail, having been described, it only remains now to explain how the lower counter-rail may be laid off to its round-up and round-aft, upon a square, for the moulds to be made. Draw a line square from the upper counter at the knuckle of the midship-timber to intersect the side-timber, as at z in the sheer-plan. Then take the distance from the knuckle of the lower counter at the side-timber to the square line z, and set it up the middle line from the line GH; and, to the said line, square down the breadth of the stern at the lower counter from the horizontal plan of the stern, and sweep a curve as before described for the upper counter, and that will be the round-up of the lower counter-rail on a square, to which the mould must be made. Then, for the round-aft on a square, take the distance from the midship-timber to the side-timber in the direction of the square line z in the sheer-plan, and set it up the middle line from the line GH; now sweep a curve to the breadth of the stern, before set off for the round-up, and that curve will be the round-aft on a square of the lower counter-rail to which the round-aft mould must be made. The curves of the lower counter-rail, on a square, are not shewn in the plate, in order to avoid confusion; and, being similar to the upper counter-rail, already shewn, the foregoing explanation will suffice.

CHAPTER V.

OF THE METHOD OF CONSTRUCTION CALLED WHOLE MOULDING.

Having now explained the usual methods of forming the draughts, and of laying off the several plans of a Ship, we shall describe the method called *Whole Moulding*.

Whole Moulding is a method of constructing the body of a vessel so, that one mould, made to the midship-bend, with the addition of a floor-hollow, will mould all the timbers, below the main-breadth, in the square body*. Ships' Long-Boats are now the only vessels in which this method is practised; and of one of these the plan, with an elucidation of the subject, may be seen in Plate 29.

The art of whole moulding depends entirely upon judiciously forming the rising line, with its half-breadth or narrowing, which must ever vary according to what the boat is designed for, whether for burthen or velocity: for, by whole moulding no more is narrowed at the floor than at the main-breadth; nor must the rising line lift any more than the height of breadth, that is, they must run parallel to each other.

The forming of the curve of the rising line requires some practice, so as to answer the end designed: for the draughtsman must comprehend, in his mind, both the form of the midship-bend and of the intended capacity of the boat; by which he may readily know how much to lift the rising line afore and abaft without lessening too much her internal capacity. See the rising line in the plan of the Long-Boat.

The depth of the boat is given in the table of dimensions, and the height of the main-breadth, at dead-flat, is a few inches below it, and continued thence, forward and aft, parallel to the rising line in the direction of the square timbers; which must be so as far as the body is intended to be whole moulded.

Enough has been already said, on drawing of the other lines, to render it unnecessary for us here to describe any others besides those which immediately relate to whole moulding.

The form of the midship-bend is now to be considered; its main-breadth, being given in the table of dimensions, may be described by the segment of a circle, whose radius may be the distance between the rising line and height of breadth line, the centre being fixed in the latter

* See the article " Whole Moulded" in Chap. I. Book I. page 75.

line, as all above may be perpendicular; or, as the midship bend in the plan of the long-boat, Plate 29. Then, from the side of the keel to the back of the curve forming the upper part of the midship bend, may be drawn a straight line or a curved line, similar to that in the plate.

We may now proceed to form the other timbers in the body plan thus; take the height of the rising line at each timber, in the sheer plan, afore dead flat, and set off those heights and above parallel to the base line, or upper edge of the rabbet in the fore body: the same must likewise be done by the height of breadth-line. Then take off the several half-breadths corresponding to each, from the half-breadth plan, and set them off on their respective heights from the middle line in the body plan. Now, let a mould be made to the form of the midship bend, from the rising line to the topside and a few inches above, faying also along the rising line: then let the lower part, which is straight, be laid upon the several rising lines, with the upper part just to touch the spot for the half-breadth on the half-breadth line, corresponding to that rising line upon which the mould is placed. A curve may then be drawn by the side of the mould to the rising line. In this manner we may proceed so far as the rising line is parallel to the height of breadth line. Then, a hollow mould must be made to the curve that completes the lower part of the midship bend, letting it run some length beyond each way, as that marked Floor Hollow in the plate. This is applied in such a manner, that some part of the hollow may touch the side of the keel and back of the curve before described by the bend mould, beginning forward. The floor hollow will always come lower on every timber, till we come to the midship timber first designed.

Having thus formed the timbers, as far as the whole moulding will serve, (for the after body is formed exactly in the manner just described,) the timbers close forward and aft are next formed. Their half-breadths are determined by the sheer and half-breadth plans, and are the only fixed points through which the curves of these timbers must pass. Some form these after timbers before the whole is moulded, and then make the hollow mould, which will be more straight than the hollow of either of these timbers. It is indifferent which is first formed, or what methods are used; for, after the timbers are all formed, though every one may appear very fair when considered by itself, it it yet uncertain what the form of the side will be. In order then to determine this, run several ribband or water-lines; and, if these do not make fair curves, they must be rectified, and the timbers from them. From these, also, the form of the transom may be described, letting the lower end of it be clear of the load water-line, that the boat may have no dead water to draw after her.

This method of whole moulding will not answer for the long timbers afore and abaft. Consequently these are generally canted in the same manner as those of a ship.

In order to render this explanation the more complete, we shall here describe the manner of moulding the timbers, after they are laid down in the mould loft, by the bend mould, rising square, and hollow mould.

The same method is used on the loft floor as was used in constructing the draught; the only difference in this case is, that it is laid off to its full size, and the moulds made to the proper scantling. Now, when the moulds are set, as before directed for moulding or shaping each timber, let the middle line, in the body-plan, be drawn across the mould, and draw a line across the hollow mould at the point where it touches the side of the keel. Next let them be marked with, the name of each timber as shewn in the plate. The graduations on the mould will therefore be exactly the same as the narrowing of the breadth. Thus, the distance between ⊕ and F on the mould is equal to the difference between the half-breadth of the timber F and that of ⊕.

The height of the head of each timber is likewise marked on the mould, and also the floor and breadth sirmarks. The floor sirmarks may be that point where a straight-edged batten touches the back of the mould, the batten being so placed as to touch the lower edge of the keel at the same time. The several risings of the floor and heights of the cutting down line are marked on the rising square, and the half-breadth of the keel set off from the side of it.

The moulds being thus prepared, as represented in the plate, we shall apply them to mould floor timber F.—The two moulds being made alike, and crossed on the reversed side, lay one upon the other as there shewn.—The timber being first sawed to its siding (commonly called a flitch) keep their lower edges in a straight line, and move them until each corresponding middle line on the moulds agree; and, likewise, so that they may best answer the round according to the grain of the wood.

The moulds in the plate are fixed at timber F; but, as the middle line on the lower mould cannot be seen, it is best to mark the middle lines also upon the edges.

When the moulds are placed, fix the inside edge of the rising-square, to the middle line on the mould of the timber, and the other edge of the square will represent the side of the keel, which may now be rased upon the piece. Then move the square till the side of it comes to F on the mould: then a line being rased by the side of it, will represent the middle of the keel. The other side of the keel must be rased after the same manner, and the point F, crossed on the rising square, be marked on each side of the keel, and a line rased across at these points to represent the upper edge of the keel. From this line the height of the cutting down line at F must be set up and squared across, and then the rising square may be taken away, and the timber may be rased by the side of the mould, both inside and outside, from the head to the floor sirmark; or, it may be rased lower if necessary.

After the sirmarks and heads of the timbers are marked, the floor moulds may be taken away, and then the hollow mould applied to the back of the sweep in such a manner that the point F upon it may intersect the upperside of the keel, before set off from the rising square; and, when in this position, the timber may be rased by it, which will complete the outside of the timber. The inside of the timbers may likewise be formed by the hollow mould. The scantling at the keel is given by the cutting down before set off. The mould must be so placed as to touch the sweep of the inside of the timber formed before by the floor mould, and pass through the cutting down point.

In the same manner mould the other arm of the floor, by canting the square. But the rising and cutting down must be marked on both sides.

But, as we intend that only one rising square shall be used, the fore body is rased on one side, and the after body on the other. It is here necessary to observe that, when the square is wanted on the opposite side, it is requisite to chalk, on the edge of the square, the rising and the cutting down for the timber you are going to mould; and then to cant the square.

The mould for moulding the futtocks is made similar to the floor moulds: only it extends upwards to the top of the sheer. The same method of fixing the rising square for the moulding of the floors will serve to mould the futtocks, as may be readily seen in the plate. When the inside of the square appears fixed to the middle line on the futtock mould for 8; then the hollow mould, applied to the back of the futtock mould, in such a manner that the point 8, upon it, may intersect the rising of 8 on the square, gives the moulding of the outside of the futtock.

The inside may be moulded in the same manner as the floors. Before the moulds are moved, mark the main-breadth, head, and sirmarks, or floor-head, in the same manner as the floors, in order to place the futtock to its proper height at the side of the floors, in case they should not be required to run down to the side of the keel.

You may make two futtock moulds, or cross the fore body on one side of the mould and the after body on the other; then, in order to mould a futtock for that side where the sirmarks are on the under side, chalk over the sirmarks for the required futtock on the edge of the mould; or, make two margins on the edge of the mould, reserving one for the fore body and the other for the after body, and reverse them on the opposite side.

If the futtocks of the long-boat are only to run down half-way between the floor-head and side of the keel, the heels should be marked on the futtock mould though moulded by the square; for then the edge of the square may be put to the proper mark on the mould for the heels of the timbers.

The use of the sirmarks is, to find the true places of the futtocks; for, as they are cut off short of the keel, they must be so placed that the futtock and the floor sirmarks may be compared and coincide. Notwithstanding which, if the timbers are not very carefully trimmed, the head of the futtock may be either within or without its proper half-breadth; to prevent which make use of a half-breadth staff.

The half-breadth staff may be about three quarters of an inch square, and of a convenient length. Upon one side of it are to be set off, from one end, the several half-breadths of all the timbers in the after body; and those of the fore body on the opposite side. On the other two sides are set off the several heights of the sheer, the after body on one side, and the fore body on its opposite. Two sides of the staff are to be marked *half-breadths*, and the other two sides, *heights of the sheer*.

The staff being thus prepared, and the floor timbers fastened on the keel and levelled across, the futtocks must next be fastened to the floor timbers; but they must be set first to their proper half-breadth and height.

The half-breadth staff, with the assistance of the ram-line, serves to set them to the half-breadth: for, as the keel of a boat is generally parallel with the horizon, therefore the line at which the plummet is suspended, and which is moveable on the ram-line, will be perpendicular to the keel. Whence we may set the timbers perpendicular to the keel, and then set them to their proper half-breadths by the staff. When the two sirmarks coincide, the futtock will be at its proper height, and may be nailed to the floor timbers, and also to the breadth ribband, which may be set to the height of the sheer by a level laid across, taking the height of the sheer by the staff from the upper side of the keel. By these means we shall discover if the ribband be exactly at the height of the sheer; and, if not, the true height may be set off by a pair of compasses from the level, and marked on the timbers.

CHAPTER VI.

PRACTICAL DIRECTIONS FOR THE ACTUAL BUILDING, PROGRESSIVELY ARRANGED.

§ 1. DIRECTIONS FOR THE VARIOUS PARTS OF THE SHIP.

A SLIP being provided, the blocks are laid at the distance of about five feet asunder, to receive the keel, from which the structure is to be raised. Each block is laid upon a ground-way in the middle of the slip, unless a small vessel is intended to be built where the launch has been laid for a large ship. In this case, by keeping the blocks towards one side, the sliding planks may be made to answer for that side. The blocks, being the foundation of the whole, must be very carefully fixed. The lower tier should be large, as a base; and fayed upon the groundways, that they may be steady, with the corners nailed down. Upon the lower tier of blocks is fayed another tier; and the upper tier is composed of such as are sawed about sixteen inches broad, from two to three feet long. and the upper corners taken off with a snape endways. These blocks are fastened to the lower blocks, with a treenail in each end, and upon them are fayed caps of oak, as broad as the upper tier of blocks, and as deep or deeper than the false keel is thick. The caps are treenailed down to the upper blocks without the sides of the keel; and they should be clear grained, that they may split out the easier when the false keel is put under.

The height of the blocks and their declivity must be seriously considered. These particulars depend wholly upon the magnitude of the ship and depth of water it has to launch into. Be particularly careful that the fore-foot is kept clear of the after groundways in launching, allowing for the settling of the ship.

The declivity of blocks to build upon is generally from three-fourths of an inch to one inch in a foot. The upper sides of them are made straight fore and aft, and level athwartships; sometimes the after blocks are raised above a straight, as the great weight of the stern and overhanging generally settles in building. *See the Frontispiece.*

KEEL. The keel is generally of elm, sawed full to the dimensions given in the Tables; but, in sawing the scarphs be careful to allow thickness enough at the lips in addition to those in the Tables, that there may be substance sufficient in the scarphs to raise the coaks, which are from one inch to one inch and a quarter thick. The workmen trim the several pieces that the keel is composed of, strait and square. The scarphs have a coak raised towards the lip, and a coak sunk from half the length of the scarph. The breadth of the coaks is one-third of the depth of the keel and placed in the middle. The several pieces are fitted together and made to fay neatly in the scarphs; then taken asunder and lined one quarter of an inch on the lower edge of one of the scarphs, and wear off at three or four inches upwards for caulking.

The rabbet for receiving the bottom plank may be trimmed out, leaving about two feet from the ends of the scarphs for reconciling. The rabbet is lined down from the upperside of the keel to the thickness of the bottom plank, in the navy; but, in most merchant ships, the rabbet is taken out in the middle of the keel to prevent its canting. The rabbet is sunk in by moulds made to the shape of the body from the mould loft.

The keel is now placed on the blocks, and tarred flannel laid between the scarphs. The scarphs are next bolted; with the upper bolts kept just below the rabbet and the lower bolts about four inches up from the lower edge for caulking. The keel is then canted for caulking the scarphs. After it is canted back, it is set fair and straight along the middle of the blocks; and, to keep it in that position, treenails are driven in. The blocks along the sides of the upperside of the scarphs are then caulked, and an oak batten, three-quarters of an inch thick, is let in over the joint of the scarph with tarred flannel under it.

DEAD OR RISING WOOD. The Dead or Rising Wood is of oak timber, of various thicknesses, trimmed and fayed upon the upperside of the keel. The pieces along the midships are of the thickness given in the Table of Dimensions, and, in breadth, to overhang the keel about two inches on each side. The scarphs give shift to the scarphs of the keel, and fasten thereto with treenails. The deadwood afore and abaft, for the security of the half timbers, is to be tabled together, and to be of such height as to answer with the underside of the keelson and give shift to the scarphs of the main keel and to each other. This part of the deadwood below the stepping is trimmed to the shape of the body by moulds.

The deadwood above the stepping or bearding line is trimmed to a perpendicular and to a parallel thickness.

STEM. The stem is composed of two or more pieces of oak timber, of the best quality, as shifting it is very expensive. It is first sawed and then trimmed to its siding given in the Table of Dimensions, out of winding, and then moulded square from the siding to the stem mould. The several pieces are scarphed together with a hook-coak as the keel; the scarph at the lower end is trimmed out to the boxing; the other scarphs the flat-way. The rabbet is next trimmed out, leaving wood in the way of the scarphs to reconcile.

On the stem should be marked, from the mould, the heights of the harpins, decks, cheeks, &c. and a line square from the keel as a guide to set it by.

APRON. The Apron is first sawed and then trimmed straight and out of winding to the siding given in the Table of Dimensions. It is fayed to the inside or aftside of the stem, to succour it in the scarphs; then moulded square to the size given in the Table of Dimensions. The scarphs of the stem are then bolted through the stem and apron, and clenched thereon. Tarred flannel being previously laid in the scarphs, observe to place the bolts within the rabbet.

BOLLARD TIMBERS. The bollard timbers are sawed, then trimmed and fayed to the side of the stem, or apron, with the aftside straight to fay to the hawse-pieces: then moulded and trimmed to the bevellings. They are connected by coaks or tablings to the stem or apron, and bolted wholly through, wherever practicable.

HAWSE-PIECES. The hawse-pieces are sawed, then trimmed strait to the sidings, as in the Table of Dimensions, to fay to the bollard timbers, and to each other, in wake of the hawse-holes; then moulded and trimmed to the bevellings, and separated above and below the hawse-holes for the admission of air, to about one inch and a half. When in their places, they are to be bolted to the bollard timbers and each other, clear of the breast-hooks and hawse-holes. Let it be observed that the hawse-pieces should be so disposed as to be equally cut by the hawse-holes.

STERN POST. The stern-post should be provided for the top end to work upwards if to be gotten, and sawed full to the given dimensions.

To trim it, let the aftside lay upwards, and get a middle line thereon: set off from this middle line, equally, the siding of the post given in the dimensions, and trim it straight through and out of winding. After it is canted, the mould will describe the size, the fore and aft way, and likewise the rabbet, the length at the head and heel, and the stations of the transoms and harpins.

Cut off the heel, allowing for the length of the tenons, which is one-third of the depth of the keel, and their thickness, or athwartships, one third of the keel; the thickness at that place and breadth, or fore and aft, twice their thickness; from the latter size to taper three eighths of an inch each way in the length.

The rabbet is next trimmed out, at the upper end, to an equiangular triangle, to the thickness of the bottom plank; and, at the lower end, or heel, to about a half inch standing bevelling from the aftside of the rabbet. The foreside of the post may then be moulded to the bearding, or shape of the body, on each side of the middle line, and trimmed thence to the depth of the rabbet. The fore and aft tapering of the post may be then trimmed to what the keel tapers in the breadth of the post, at the heel, wearing off at the tapering up the back. When the post is trimmed drive an iron hook over the head to prevent its flying.

INNER POST. The inner post is sawed to the given dimensions, then trimmed to its taper, and fayed upon the foreside of the main post, the head to let up one inch into the underside of the transom next above it. It is fastened to the main post with treenails, and a tenon is made at the heel as on the main post.

TRANSOMS. The transoms are sawed to the sidings as in the Table of Dimensions, whether rounding upwards or straight; and to their shape to the moulds. The wing-transom, if sawed only to the margin bevelling, may be brought in for other uses if found defective: for transoms require much trouble and expence to shift them, and the quality of the timber ought, therefore, to be of the best, and quite free from any defect whatever. In converting the transoms, let care be taken to work them top and butt.

The transoms are to be trimmed with the greatest exactness, and then let on the post, with scores on each side, of an inch deep or more, observing great precision as to letting them down, horning, and position. The ends, when cut, are left long enough to tenon, and face on to the fashion-pieces one inch and a half.

The ends of the filling transoms may be cut with mouths for air, in the same manner as beams.

FRAME TIMBERS. It being of the greatest consequence to the formation of the ship, that all the frame timbers should be sawed square, but, more particularly, trimmed very correctly to the moulding and bevellings. They are mostly sided straight, and out of winding, except where any particular timber requires a cast, to make a port, &c. But, with filling timbers, the grain of the wood had better be followed in the siding than be grain cut, to make it straight, if the piece should not have grown so. With great care the bevellings or windings, as they are applied, should be kept out of winding from one spot near the middle of the piece.

The frame timbers should be converted of sound well grown wood, without sap or vein appearing in wake of the ports, and full to their sidings, so that their scantling may remain after the port is trimmed out. Every timber should also be provided to its length; consequently, each should stand upon its proper head. Or, if one timber happens to be short, provide the next long enough to make good the deficient length, as *through-chocks* should always be rejected, or only admitted on extraordinary occasions. The heads and heels of all the timbers to have one third of the substance left the moulding way when trimmed, and the seats of the chocks should not exceed once and a half the siding of the timber.

In providing floors, care should be taken to reverse the butt end of each succeeding floor; because the tops may sometimes be scanty; and, when short of the floor-head, may be admitted if the second futtock runs down and meets upon its respective floor.

Where timbers wind or twist much, as the fashion-pieces, &c. they should be counter moulded; especially when the sawyers may be depended upon.

FLOORS. Floors, excepting cant-floors, are generally sided straight to the given dimensions, and then moulded as follows. Say, for example, one of the midship floors, which are represented by ⊕ (1) (2), &c. as in the sheer-draught, Plate 1. Take the two floor moulds and lay them on the timber, placing the end of the one over the end of the other, and moving them till the middle line of both are exactly well with each other, and the under part of both forms one straight line. They may be then confined together in that position, either by a nail or gimblet, just to hold them together for the present. Next set off, from the middle line on the moulds, the half siding of the keel, at which place apply the rising square, keeping the arm which is not marked well with the lower parts of the moulds; then to the side of the rising square apply the cutting down batten, keeping the lower end of it well with the line marked ⊕ on the arm of the square. We shall now see whether the piece will make the floor by moving the moulds downwards (taking the greatest care not to alter their position) till the line marked dead-flat, on the cutting down batten, is well with the upper part of the piece; then, if there be wood sufficient at the outside of the moulds at both ends, and likewise whole wood below the cutting down, according to the dimensions, the moulds may be rased by on the timber. Then, by taking the floor-hollow, and keeping that line on the lower end, marked for the side of the keel, well with dead-flat on the rising square, and the other end well with the floor-mould, the true shape of the floor will be described from the head to the side of the keel; and we shall thereby see the size and shape of the chocks, which will be required to make the undersides of the floor next to the keel.

The operations of moulding the floors by this method are all alike, and performed just in the same manner as those of dead-flat; only observing to leave sufficient wood in the throats of those floors which have bevellings where the cutting down rises.

When a frame of battens is made to take all the floors of the square body, or nearly so, the floor is moulded by boring holes, with a small gimlet, at the sirmarks and head; and the floor is moulded by its corresponding first futtock mould being applied to the holes as bored.

The cutting down is marked in the same manner from the mould, and the scantlings are next set off square from the sirmarks. The inside of the floor is moulded by a thin batten tacked thereto, and thus will the moulding shape of any floor be obtained.

After the floors are sawed, as above described, they are to be very correctly trimmed by the shipwright; for the truth and precision of the whole fabric may be said to depend upon the accuracy of the floors when got into the ribband.

In trimming the floors, let the chocks be first fayed that make good the deficiency of the underside next the keel. Then trim the joint-side straight and out of winding, as before observed. The joint's side in the fore body, is the aftside of the floor, and in the after body the foreside. The floor is now to be sided parallel to the joint-side, to its siding dimensions; then moulded and trimmed, very correctly, to the bevellings as before described. From the joint-side, the inside of the floor is next trimmed to its cutting down and scantling: scores may then be taken out, on the underside, to seat them on the dead-wood, observing to keep the given substance below the cutting down; *and, that the cutting down be not raised to gain that substance.* In merchant ships the floors have scores cut on the underside, about one foot out from each side of the keel, to let the water come freely to the pumps.

The RISING FLOORS, particularly those close aft, are, from the acute angle they form, very difficult to be gotten; and, as a substitute has induced many to make them of three or more pieces called *made floors*, and those are most to be preferred that are made the strongest from straight timber. Let Fig. 1. in the margin, represent one near aft, with a short arm on the larboard side, and the deficiency made good by a piece scarphed on and bolted. The respective first futtock is to be bolted fore and aft to both parts.

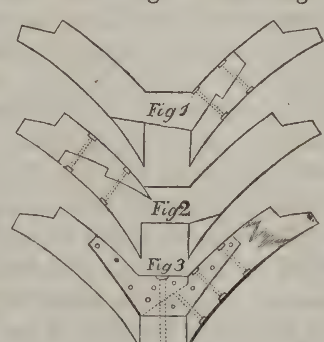

Fig. 2. is similar, but more out-square, consequently easier to be obtained.

Fig. 3. is composed of two straight pieces, scarphed together in the middle, with a lap scarph. Upon the foreside of the lap scarph is fayed and bolted a chock, extending equally from the middle line; and, in depth, from the cutting down to the upperside of the score; sided the same as the lower futtock, whose heel fays with a corresponding scarph to the chock, and is bolted as shewn in the figure. This may be deemed sufficiently strong for this part of the ship.

The floors, when trimmed, are crossed in their respective situations, in scores cut in the deadwood, to the exact height of the cutting down, set correctly level, and horned, or squared, from the middle line. In the Royal Navy and most Merchant Ships, the floors are bolted through the keelson and keel. It may, therefore, be necessary to drive a small bolt in some of the floors, that they may not rise when ribbanding. Be careful to place this temporary fastening clear of the keelson bolt, which is in the middle of the floor: or, which is better, drive a temporary eyebolt, hand-taught, through the hole in the middle of the floor, and forelock it under the keel; as this hole may hereafter be bored upwards with a *joint-auger* through the keelson. The floors may then be ribbanded and shored. The shores to be capped, nailed at the head, and nogged at the heel.

FUTTOCKS. *Lower futtocks, second or middle futtocks, third futtocks, fourth futtocks*, and *toptimbers*, are first sawed and then trimmed to the given dimensions, similar to the floors. In the Royal Navy, the heels of the lower futtocks run down to the dead-wood; but, in Merchant Ships, they are from nine to twelve inches short of the side of the keel, that water may not lie above the ceiling. The wood wanting on the inside of the lower futtocks, in the navy, is made good by chocks, fayed across, up to the cutting down.

The timbers that compose a frame, or bend, are bolted together, either close or opened, as required; the joint side of the second futtock to the joint side of the first or lower futtock, agreeably to the shift or scarph, as given in the dimensions. The heel of the third futtock joins the head of the first or lower futtock, and bolts to the second with bolts of the number and size given in the Table of Dimensions. The iron being square, the heel of the fourth futtock joins the head of the second, and bolts to the third; and the heel of the toptimber scarphs on the head of the third futtock, and is bolted or fastened with treenails to the fourth futtock; taking care that no bolts be driven in wake of the ports or port-sills. *See Midship Sections, Plate* 8.

The frames, when bolted together, have chocks fayed in the seats at the heads and heels, and fastened with treenails: and, to prevent their straining, when hoisting, quartering is sometimes nailed over the joints of the chocks and timbers, and a shore, fitted on the inside, or bag of the frame, and stopt at the head and heel with cleats. A chain is then set taught round the back of the frame. This should be carefully attended to; for, if the frame be strained in hoisting, its form becomes altered, and the true shape of the body lost.

The frames are raised into their places by tackles, which are lashed to sheers, or travel upon a *ridge-rope*. One tackle is applied to the heel of the frame to lighten it off the ribband, and one or two near the main breadth, and another to the heel, to prevent its going too far into the ship. Some cant the frame, and heave up the heel by one of the breadth tackles, landing it on the ribband; and, then, to prevent it from going too far into the ship, they bore a hole, and thrust in an eyebolt, which stops it against the ribband.

The frames as hoisted are shored and cross-spaled, either in the ports or at the main-breadth. Upon the cross-spales is marked the middle line and the breadth of the ship at the place of spaling, to which the outside of the frame must exactly conform, before the cross-spale is nailed. In the turn of the body, as the cross-spales cannot be nailed in the joint, the breadth must be squared in. Observe that, when the frames are cross-spaled in the ports, they need not be cut at the ends, but may remain till the ship is planked, and the beams in and knee'd. The only objection to spaling in the ports is, that it is thought by some to be too high.

The frames may now be ribbanded thus: the cant-frames may be gotten near to their stations by the harpin moulds, then the harpins gotten up; and, if the frames come fair, may be nailed and shored to their sirmarks, seeing that the frames are exactly levelled; or, in other words, that, by a plumb suspended from the middle line on the cross spale, each is found to agree with the middle line on the keel or floors.

The square frames being levelled, as just described, and the floor sirmark or guide exactly corresponding, set them square from the middle line and keel as follow: stretch a line athwart, at the main-breadth, or at any distance parallel below it; then look this line and the joint of the frame out of winding, to the edge of a batten (by some called a rake and level) fixed in the middle line. The batten tapers in its length, from a straight edge, equal to the set of the ship in every foot; so that, when the raking edge is kept aft and set plumb, the straight edge should correspond with the line at the breadth and joint of as many square frames as you may please to set, which may be every fourth.

The spacing of the ports may likewise be proved by a long staff, upon which their stations are to be marked, as taken from the floor or mould-loft. The ribbands may be then nailed and shored; and, to prevent their altering afterwards, let them be nogged at the heels and cleated.

The lower futtocks are now to be bolted to the floors similar to the shift or scarph above: and, in large ships, along the uppersides of the lower cross-spales, are to be nailed two rows of deals, about nine inches on each side from the middle line, and a ribband nailed down near each midship edge. To the ribband the topside is shored, and kept steady at each frame by being cleated over the heads, in the range of the toptimber line; each lower cross-spale being shored underneath upon the keelson.

HARPINS. The harpins are sawed to the moulds and bevellings; then trimmed, and scarphed together with a key-scarph, because of their curvature. They consist of two or more pieces, and the scarphs are lined over, with oak or elm board, to strengthen them.

KEELSON. The keelson is sawed, and then trimmed to the given dimensions, thus: the sides are trimmed straight and out of winding, and the upperside square from the sides; the underside is fayed close upon the floors and cross-chocks; but, previous to this, the openings between the floors and cross-chocks are filled in with pieces of dry oak driven down tight, with the grain athwartships, to the siding of the keelson and close down to the dead-wood. Then, between each floor, scores are taken out, as low as the keelson is to be let down, according to the Table of Dimensions, and likewise to its siding. The different pieces of keelson may then be fayed, either by a given mark or by counter-moulding. By the former, shipwrights sometimes get each piece of keelson into its place, as it comes from the sawyer, and with compasses square up the butts of all the scores on each side: then, by taking with the compasses the greatest distance, let that be a parallel mark to be pricked upon the piece from the surface of the floors, also the scores at every butt. Lines may then be struck to every spot, which, when trimmed straight through the piece, will consequently fay into the place designed.

To fay a piece of keelson by counter-moulding, proceed thus: Fay a piece of deal board, on one side, into all the scores and upperside of each floor and scarph, the whole length of the piece; then square over from the side of the mould three spots, one near each end and one in the middle, making sirmarks on the mould at each place: next take the windings or bevellings at each spot, keeping them out of winding with the middle one, and marking them on a board, or at its respective place on the mould. Then fix the mould on the same side of the piece of keelson it was made to, observing that, when fixing the mould, the depth of the keelson is preserved as given in the dimensions. Now rase upon the piece the faying edge of the mould, and the square spots for the windings; but, if there are veins on the edge, let the mould be tacked on and dubbed straight through to the mould.

Next trim through the winding spots, as they were taken, squaring them over to the other side; or prick off the windings with the compasses: then, to counter-mould the other side, fay the mould as before; but, to the opposite side, marking the square spots very correctly on the mould when fayed. Then fix on the refayed mould to its respective side of the keelson, keeping the fayed edge well with the winding spots; the square spots, at the same time, exactly agreeing. The underside of the keelson may now be trimmed straight through to the mould, and, when in its respective situation, if carefully done, it is sure to fay at once. Observe, previous to the keelson's going into its place, that all the joints or seams under it are caulked and paid, and the whole surface paid with tar.

Thus, by counter-moulding, or taking a mark, are to be fayed all the various pieces in the ship.

The scarphs of the keelson are trimmed with a hook-butt in the middle of their length; the length of the scarphs and the substance at the lips are to correspond with the given dimensions, and the middle of each scarph is to be so disposed as to come in the middle of a floor.

In the Navy, the keelson is bolted through every floor, and the bolts clench on the underside of the main keel. In East-India ships it is bolted through the six-inch keel also. Some ships have their keelson bolted through every other floor only. The bolts must be driven clear of the joint in the keel scarphs, and the bolts through the after dead-wood must be so disposed, on the underside, that one may come about nine inches from the after end of the keel, and the next bolt abaft it through the heel of the stern-post, to secure the extremities. Every bolt should be clenched upon plates or rings, of a full size, let up within the wood, and the points all caulked after the said ring or plate is let up. The keelson and dead-wood bolts abaft, when very long, are driven with two drifts, or sizes, from the middle of the length, for more readily driving the same, and the greater certainty of getting them through when so driven. The lower end of the bolt is to agree with the size given in the Table of Dimensions, and the upper drift one-eighth of an inch larger.

Many objections were formerly raised against double-drifted bolts, as, in repairs, they could not be driven out downwards. The strength of the ship, however, depends very much upon these bolts coming through; and double-drifted bolts, particularly copper bolts, are indispensable. The newly-invented machines for drawing bolts, described hereafter, have, in great measure, removed these objections; and, if a three-inch plank be wrought upon the upperside of the keelson, before the bolts are driven, this plank might be cut away upon a repair, or occasionally, when any bolt is required to be drawn out, so that the chops of the machine may take hold of the bolt. The keelson might otherwise be much wounded, and probably spoiled. Besides, this plank would have the chases of all the pillars on it, which would otherwise tend very much to injure and rot the keelson.

STEMSON. The stemson is sawed to the given dimensions; then trimmed and fayed to the apron, similar to the keelson, and scarphs with a hook and butt into the fore-part of the keelson. The bolts through the *breast-hooks* must be considered, and one or two bolts may then be driven through between them.

STERNSON KNEE. The sternson knee is sawed to its moulding and siding as in the Table of Dimensions; then trimmed and fayed against the transoms and upperside of the dead-wood, and scarphs with hook and butt into the after-piece of the keelson. It is bolted through the post and transoms as the keelson, of which it is a continuation.

WALES and PLANKING. In general, after the strakes are lined out upon the ship's side, and the butts shifted *(see Planking, Plate 3.)*, some spile for each plank with a flat batten called a rule-staff, which is tacked to the ship's side where the plank is intended to be worked. Then, upon the staff, the length of the plank is marked, and as many spilings taken as may be thought necessary, or at about three feet distance, to the line the plank is intended to be worked to; or, when plank is wrought to the edge of the plank designed to work to, a touch, or any sudden angle, must also be marked upon the staff; and, at about every three feet distance, a bevelling spot is to be numerically marked thus (1), (2), &c. as at those places the bevellings are taken and marked on a small board. The several breadths of the plank are likewise to be marked down at those spots. To apply this staff, when the inside of the plank is spiled to the spilings, breadths, &c. must be canted or shifted to the other side of the staff, preserving the spilings on their proper edge. This is evident, or else the staff cannot be applied as taken. Some, when the plank is wrought, spile to the outside edge, keeping the staff off parallel to the thickness of the plank; then the outside of the plank may be certainly lined, and the spilings applied as taken.

The workman, by applying this staff, has every opportunity of seeing if the plank will line to its spilings and breadths clear of sap, also to its length; then, if the plank will line, observe that, however unfair the spiling edge may be, always to line the opposite edge fair. Workmen who have been used to the lining of planks will line a number of them without spiling, by examining the edges which the plank is to work to.

The after lower piece of wale generally comes upon the end of the wing-transom, or sudden turn of the body; it consequently twists very much, and should be of a short length. This piece, and some below it, besides what spilings can be obtained, is generally trimmed by moulds made to its upper and lower edges. The upper edge is trimmed, or sawed, square to the timbers; the lower edge to a level, and then trimmed back, between two squares, to the thickness of the next plank under it, winding all the length from one given spot. When wrought, the outer edge is levelled in to the line on the side.

INBOARD THICKSTUFF CLAMPS, &c. These are wrought similar to the outside stuff. The clamps to the sheer of the deck, and their uppersides to the round-up of the beam, and the lower edge square from the timbers; unless they work down to the ports, then in wake of the ports. The lowersides are trimmed level, and between the ports square to the timbers, to the thickness of the stuff underneath. Clamps over ports are mostly bearded from half their depth to one inch less in thickness on the underside, excepting in the middle. Over each port is left a semicircle, for the muzzle of the gun to house to.

The Thickstuff is to be wrought with a square close edge, over the joints of the timbers, and the spirkittings are to have a seam allowed agreeably to the thickness with the outside stuff; that is, to every seam and butt of two inches thickness, a seam of one-eighth of an inch; to every one of two inches and a half thickness, three-sixteenths; of three inches, one quarter; of four inches, five-sixteenths; of five inches, three-eighths; of six inches, seven-sixteenths; of seven inches, one half-inch; of eight inches, nine-sixteenths; of nine inches, five-eighths; and of ten inches, to have a seam of three-quarters of an inch.

BEAMS. Beams, whether whole or in pieces, are sawed to the siding and moulded to the round-up and moulded depth, square from the siding, as given in the Table of Dimensions. If the sawyers cut their work true, let them be counter-moulded at the saw-pit, as they will then require no trimming by the shipwrights but scarphing together. In the conversion of beams, if they are in one length, provide them top and butt; that is, let every other one have the butt of the tree on the same side, as the butts are more likely to decay than the tops. Again, observe that, in siding beams, as far as the arms of the lodging knees fay (which is on the aftside in the fore-body, and on the foreside in the after-body), provide the butts with a tail as large as the butt of the tree will admit, which will cause the knees to be more out-square, and they may consequently be the more easily provided. And quite forward a tail left on the foreside will greatly assist the bevelling of the hanging knees by bringing them near a square.

In large ships, beams are composed of two, three, and sometimes four, pieces, and are allowed to be stronger than in one. Beams so made, have scarphs tapering towards the top to about four inches, allowing the thickness of the tables, and the seat of those scarphs are to be sawed straight and out of winding.

Beams in two pieces have a scarph one-third of the whole length of the beam, like the fore and aftermost beams shewn in the Plan of the Gun-deck, Plate 5. Beams in three pieces have the middle pieces and end pieces each half of the length of the whole beam, the middle piece having a scarph each way to take the arms, as shewn by the midship beams in the Plan of the Gun-deck above mentioned. Beams made of four pieces have two middle pieces, each similar to the former; the arms and middle pieces are each to be of three-sevenths of the whole length, as the twelfth beam from forward, shewn in the Plan of the Gun-deck.

The general method of scarphing beams together is, to table them; the lengths of the tables being about once and a half of the moulding or depth of the beam. The tables are divided in the middle of the depth; and, where the wood is taken out on the upperside it is left on the lowerside, and so alternately, taking the wood out on the upperside of the scarph at the table next the butt end, as it will the better hang and support the lip. At each lip, beyond the tables, is a coak about six inches long, and next to it is a straight lap of the same length.

Scarphs taken out in this manner are liable to retain water if the deck should leak, which must be the means of rotting the beams: but, if the beams were tabled together in dovetails, and taken through from the upper to the underside, putting tar only between them, which hardens the wood, the water then would have a free passage, and the beams would dry again. This method is not inferior in point of strength to that of tabling the beams just described.

The scarph which is thus tabled is to be laid upon the scarph it is to fay to; each piece to be kept straight sideways and out of winding, and well to the round-up mould: the butts of the tablings and coak may then be rased upon the scarph to be fayed; then a parallel mark with compasses, is to be taken at the greatest opening, which may be pricked off at every butt, and rased across at the ends of the lips. The piece may then be lined to those spots, and the tables, &c. trimmed out as before. The scarphs are now to be well dried, by burning reeds or shavings on them, then paid with tar, and set close together and bolted at every eighteen inches distance, at about three inches down from the edges; and the lips fastened with two small bolts or nails. The bolts are to be driven each way from each lip.

The beams, when put together, are cut to their lengths, thus: Stretch a line across the ship at the station or order upon the side; then, with a sliding staff or two staffs (confined together by nails or gimlets) take the length across the ship in the direction of the line. Thus may many lengths be taken, marking a line across the battens with a pencil, and numbering the beams in order. The bevellings are then taken from the said line, thus: Fix the tongue of the bevel against the side well with the beam line, and open the stock to range well with the line across the ship, which gives the fore and aft bevelling; the up and down bevelling is next taken, by fixing the tongue to the side, and opening the stock till it is out of winding with the line athwartships. These several bevellings may be marked on a board, marking their respective sides, and number of the beam. To set off the length and bevellings, as taken, strike a straight line upon the same side of the beam as the line was fixed to in the ship, and along this line apply the staff with the length, and from that length set off the bevellings as taken; this is the true length when the beam has its proper round-up or nearly so. But the truest method of taking the length of a beam is, to set back from the station a four-inch sirmark on each side, on the beam line, in the centre of which stretch a line to each side. Then take the length and bevellings as before, and set off this length straight on the beam mould, and open the battens to that length on the round of the mould, there confining them. Then, from a straight line ranged along the side of the beam that the length was taken from, set back, upon the upperside, the four-inch sirmarks, parallel with the line, one in the middle and one at each end: then, laying the battens to these sirmarks, set off the last length taken, which gives the true length of the beam, whether it has its round-up or not. The bevellings are set off as before.

Observe, before the lengths are taken, and when the beams are to be let down, that the lips are kept as much from the order or station on the side as may keep them athwartships, or square from the middle line, and clear in the hatchways: and, likewise, that the upperside of the beam is out of winding with the beam line at the side.

The ends, after they are sawed off, are snaped back on the undersides one-fourth more than the siding of the lodging knees, or so as to let them down in the clamps according to the dimensions. The ends are then mouthed, or a mortise is cut, through the heart, about two inches wide, and one inch and a half within the clamp, wearing off on the upperside that air may come to the heart at all times: or, the heart may be bored out with an inch and a half auger about eighteen inches in, and another hole bored up from the underside, to come into the former at about one inch within the clamp, with an auger of half the size, to admit air to the heart. The ends are then burnt very dry, and a hot bolt thrust into the heart once or twice till it is cold.

KNEES. The knees are first sawed or trimmed to the siding given in the dimensions; then fayed to their respective places by a mould and bevellings, taking as little wood as possible out of the throat the moulding way; the strength of the knee being there. Towards the toe each tapers to what it is sided. No chock should be admitted on any knee that would reduce the throat or moulding of the knee less than its siding.

Lodging and *Dagger Knees* should have a coak left at the crown, when the grain will admit, to let into the beams one inch and a quarter, at about nine inches from the side. The coak to be from four to six inches broad, and within one inch of the underside of the knee. When the grain will not admit of a coak, a hook is left, about nine inches long, within the toe. After the knees are fayed and bolted, an iron key may be driven down the side butt of the coak.

In bolting the knees, place the holes alternately on each edge, and the throat-bolts in the side arm of the hanging knees as high as possible, keeping the upper hole in the range of the underside of the beams, and stiving it upwards to come through the end of the lodging-knee behind it, and the next hole about four inches below it, stiving it rather above a level. The other holes are to be equally spaced between that and the toe hole, which is kept up full the siding from the end, and may be bored square with the body or to clear the seams. *See Midship Sections, Plate* 8.

In those parts of the ship afore and abaft, where wood knees cannot be procured of kindly growth, (for upon that depends the strength) knees of iron are generally placed. These, although they are now much used, particularly in merchant ships, cannot be so fully depended on as those of wood, because they cover less surface, are nowise flexible, nor can the bolts be driven so tightly in the iron as in wood. If, therefore, the ship strains, they must inevitably work loose: again, the holes must be bored in the direction in which the knees are punched, so that, where iron knees are intended to be placed, oak fillings should be driven between the timbers; otherwise the bolts may come in the openings, which is inadmissible. Besides this, the bolts may happen to come in the seams of the outside plank; when it so happens, the best way is to cut out a piece and clench the bolt upon the timbers.

Bolts in wood knees are driven from the outside and clenched upon the knees inside; but bolts in iron knees are driven from the inside, with collar or stout heads; because, upon the head depends its fastening. Or, if the bolts be of copper, they must have a ring under the head, and the head spread or made large in driving. All bolts driven from the inside should be carefully clenched upon rings, let flush into the planks, by means of a bitt for that purpose, and the points caulked after the ring is let in.

Wood for knees having, from its peculiar figure, become scarce, many substitutes have been attempted, and iron knees, or, rather, knees formed conjointly of iron and wood, as described hereafter, are certainly the best, when properly applied. *See Plate* 8.

Made-knees of wood have been constructed by foreigners, of straight pieces lapped together at the crown, and a chock fayed into the throat.

STANDARDS. Standards are sided, trimmed, and fayed, similarly to knees; but, if of wood, the toe-bolt of the deck arm should have a collar-head, and be driven through an iron plate under the head: or, which is better, through an iron strap, clasping the toe with a fore-and-aft bolt driven to prevent the standard's splitting. The point of the toe-bolt should be screw-cut to receive a nut, which should be hove taught upon an iron plate let up its thickness in the underside of the beam.

RIDERS. Riders are sawed to the mould and bevellings, and to the size given in the Dimensions; then fayed by a mark, or a square spot, and counter moulded, and then bolted through the side alternately on each edge, with the bolts equally distant. Floor riders, according to the present mode, require large pieces of oak timber. Their strength is much reduced by crossing the keelson, although very often the grain is straight at the score. We should therefore consider it as better work for the floor riders to be in two, with a cross chock fayed over their heels with a hook and butt scarph; also with their heels to work down to the limber-boards and the heads between the joint of the floor-head and first futtock head. For, at present the head of the floor rider (after taking so large a piece of timber) only comes over the joint of the floor-head, or nearly so; but, by the method here proposed, the floor-head will be more succoured by the floor-rider's running beyond it.

First futtock riders are sawed and fayed as before described. They fay close to the sides of the floor riders, and the heels extend downwards within four feet of the keelson. The head runs up between the joint of the first futtock head and underside of the orlop beam, with a cross chock over the heels and a hook-and-butt scarph. A piece may be worked from the heels to the limber boards to straiten the cross chock.

Second futtock riders are sawed and fayed as before described, and scarph with a hook scarph under the head of the floor riders, or connect thereto with a chock. Their heads run up within two inches of the underside of the gundeck beam, and are cut with a swell at the orlop beam, to which they tail sideways; and they bolt fore and aft with two bolts, and likewise fay and bolt against the side of the first futtock rider.

Third futtock riders are sawed and fayed, as before described, with a swell, to tail and bolt against the sides of the gundeck beams. They fay and bolt, fore and aft, to the sides of the second futtock riders. The heads come up within two inches of the underside of the upper or middle-deck beams, and the heels come within two inches of the upperside of the orlop beam.

Breadth riders are similar to third futtock riders. They are cut with a swell to bolt against the beams they fay to, and their lengths are the distance between the beams or decks above and below them.

Top riders are similar, and cut with a swell to bolt to the upper-deck beams. Their heads run up to the underside of the gunwale, and the heels about six inches short of the gun or middle deck.

Breadth and top riders stand diagonally, and thereby bolt to more timbers, and clear the ports better than the rest. For the methods of bolting *the Riders, &c. see Midship Sections, Plate* 8.

BREASTHOOKS, STEPS, and CRUTCHES. These are sawed to the given dimensions, and fayed similar to knees and riders. But, if a mark is taken for faying the breasthooks, it must be taken in a fore-and-aft direction, or parallel to the middle line; and, for steps and crutches perpendicular. For, were the mark taken parallel to, or square with, the body, too much would be taken from the extremities; and, consequently, would never fay. The holes for the bolts are bored alternately, near the edges, and equally asunder. The holes next the middle line of breasthooks, in the sharp part of the body, are crossed, to bring them more square with the bow. Breasthooks, Steps, and Crutches, are assisted in the moulding by chocks, and the deck-hooks may be assisted by ekeings, worked behind them, so that the hooks may seat against the stemson. All the chocks of breasthooks are tabled, and ought, on no account, to have less wood or substance than the siding left clear of the chocks.

COAMINGS and HEAD-LEDGES for framing the hatchways, &c. are sawed to the size given in the Table of Dimensions; then framed together in the strongest manner, by lapping them at the ends over each other, to dovetail each way, and the coamings to have five-eighths of an inch tail or stop into the head-ledges, taking the rabbet for the gratings out first. The head-ledges come wholly through under the coamings, and sufficiently above the deck to be caulked; above that the coamings lap over the head-ledge. A bolt is driven through each corner, in the middle of the lap, and one in the middle of the head ledge. Coamings have a rabbet taken out of the inner edge, for the gratings, about three inches on and two inches and three quarters deep. The coamings are mostly fastened with treenails, and the corners are rounded off above the deck.

CATHEADS. Catheads are first sawed to their cast and flight, and then trimmed with more exactness to their moulds and scantlings, as in the Table of Dimensions. Their outer part is cut to look up with the sheer, the sides standing perpendicular or plumb. Their outer ends cut off between a perpendicular and a square, and are secured with an iron hoop, let in flush. The sheeve holes are then cut through perpendicularly and parallel to the sides. The inner part is fayed to the cat-beams, in large ships, with a scarph on the upper side for the cat-tail to fay to, with a hook butt in the middle. In smaller ships, the inner part fays up to the underside of two or more of the forecastle beams, facing upwards one inch or more.

SUPPORTERS of the Catheads. The Supporters are generally trimmed, as the side-arms curve very much, by a mould made to the aft-side. Some trim it by two moulds; one mould being made to the curve on the side, and another to fay to the underside of the cathead, and likewise to the side in a straight direction. By this method the supporter may be trimmed near enough for a rough mark. Others take the pains to fasten brackets to the side, to its curve, at about six inches asunder; the aftsides of which gradually wind, or twist, from the aftside of the cathead to look in with its rail at the fore part. Then, to the outsides of these brackets are fayed pieces of deal, scarphed together, by which means the curve on the aftside is truly obtained, and likewise the shape of the side to which it is to fay; and, as the brackets stand square from the flight, or curve, they give the true bevellings to trim it to. By this mould the supporter may be trimmed very nearly to its work, and may then be sided and moulded correctly, and set up into its place.

KNEE OF THE HEAD. The Knee of the Head has its several pieces sawed to their various shapes given on the mould, and the tapering sideways where they cross the battens.

The main piece should make the lower part of the knee, and run up in front to take the bobstay holes. Another piece must be provided to make the lacing, and a third to fay against the stem, and run up high enough for a hole to be cut in it to receive the main-stay collar. The other pieces between may then be provided, as most convenient, marking on the mould the shape of each piece as provided, allowing to each sufficient wood for tabling and faying.

The main piece has the fore part trimmed to the mould, and then sided, agreeably to the tapering battens, from a middle line rased along the piece and over the ends. The edges on the fore part are next trimmed off with a bold round. This piece is then secured on blocks, and kept perpendicular with the middle line. The tables may now be taken out of the aftside. Each piece is then gotten on and fayed as before described, and treenailed to each other till the whole surface of the knee is completed. The aftside is then fayed to the stem.

The knee-bolts may next be set off where they are intended to be driven, and quartering nailed between to keep the whole together while hoisting into its place. The holes may then be bored, first marking every appearance of iron, &c. behind. Some prefer having the bolts to go through the middle of the hooks, as it makes the bolts more of an equal length through the knee and through the side. Others prefer having the bolts so as to come between the hooks, alledging for this practice that more fastening is obtained, and the difficulty of driving the bolts without that additional length obviated. But, after all the holes are bored, let the knee be swung off, and carefully examined behind, so that, in case there should then be any holes, they may be carefully plugged up and caulked. The knee and stem may be then paid well with tar, and set close with chains while bolting, as it is sometimes apt to start off.

RUDDER. The main piece of the rudder is sawed to its siding, and the upper part to the given dimensions, with the lower part moulded as large as the piece will admit. Whatever the main piece may require to complete its foreside must be of oak or elm, tabled to the main piece. The foreside may be then bearded from the side of the pintles, the foreside being trimmed to the form of the pintles from a middle line, correctly rased the whole length, and squared over at the ends; for, were it bearded to a sharp edge at the middle line, it would reduce the main piece more than is required; and we may observe, that, in large ships, when the rudder is hard over, the bearding will not be close to the stern-post by three-quarters of an inch. The usual mode is, to line down, on each side of the main-piece, two-fifths of its thickness; but this has been found to cut or wound the main-piece so much at the upper pintle, that, lately, the aftside of the stern-post is likewise bearded; and, consequently, the foreside of the rudder so much the less. The other pieces, to complete the surface of the rudder, may be of fir, and table on to the main-piece and to each other. The whole is then trimmed straight through, to its thickness on the aftside, and then bolted together between the straps of the pintles. The back is then fayed on and fastened to the aftside, and the sole at the heel, (when cut off to its length), with nails and treenails. The hances are then trimmed out to mouldings, and the aftside of the rudder above the lower hance is thirded and bearded back about three-quarters of an inch at the sides. The head, if not a round headed rudder, has its edges taken off with a bold round. The holes for the tiller may be now cut through, and the head hoops driven on. The pintles may next be let on thus: the braces being let on to the stern-post, and square from the aftside, a staff of the whole length, is run down through the holes of the braces, or fastened to the aftside. The former method is that which we prefer. Now mark the uppersides of the braces correctly on the staff, with a pencil, or both under and uppersides will be best. Then mark on the staff the upperside of the wing-transom and the underside of the deck-transom above; also the upperside of the deck; and, lastly, the underside of the keel. Next apply the staff on the foreside of the rudder, and exactly mark off the uppersides of the braces in the middle line, keeping the transoms clear of the holes, that the lower tiller may work near the undersides of the deck beams above the wing-transom. Then square down, from the foreside of the rudder, the upperside of each brace, which, it may be observed, is the underside of the pintles. Now set upwards the breadth of the straps, and the scores may be taken out till the crowns come flush with the bearding, and the middle of the pintle ranges well with the middle line, allowing for the upper sheathing round the scores under the pintles. Scores are then gouged out, under the pintles, sufficiently for hanging the rudder, and may be formed by a piece of sheet-lead, made to the crown of each brace, and traversed round its respective pintle. Let there be sufficient room in the scores to allow for the sheathing; and, that the rudder may hang easily, all the scores must be made to the length of the lower one; that pintle being two inches longer than the others. The score nearest to the load water mark is opened on one side to fit in the woodlock which prevents the rudder from unhanging. At some places in the North of Britain, the pintles are put into the braces, and the rudder put together in that situation, so that it cannot be unhung until throatings are cut to clear it of the braces.

After the braces are let on, it is best to try all the pintles in them, and see that they work easily in the braces, and square from the stern-post. Then their uppersides may be taken with a staff, and set off on the rudder, as before directed, without the possibility of error. The tiller and sweep may next be fitted agreeably to the directions already given for constructing the plan of the upper deck.

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§ 2. DIRECTIONS FOR MAKING CAPSTANS AND WINDLASSES.

1. OF CAPSTANS. *(See Plate of the Capstan, Plate 7.)*

First, provide the barrel of sound oak timber, full to the size given in the Table of Dimensions, and have it sawed to a polygon of ten or twelve sides, according to the number of whelps. That is, if it is to have six whelps, the barrel must have twelve sides; and, if only five whelps, ten sides.

The barrel, after it is sawed, is to be suspended at the ends by a bolt driven in the centre, upon which it turns, for the convenience of the workmen in trimming the barrel more accurately from the saw, and putting the whole together, after the squares are trimmed straight and out of winding.

The partners are next set off, and made cylindrical, from two inches above the upperside of the deck partners to three-fourths of the size of the barrel downwards, or half the distance between the underside of the trundle-head, and two inches above the deck partners. *See the Plate.*

To take off friction, iron-ribs, about ten inches long, one inch and a half broad, and three-eighths of an inch thick, are let into the partners, two-thirds of their thickness, at one inch above the partners or cylindrical part of the barrel, and fastened with nails at each end, their breadth asunder.

The whelps may be then let on; they are sawed from oak timber, and accurately trimmed to the size given in the Table of Dimensions and the scores taken out for the chocks. The fronts are next thirded and bearded towards the sides, about three eighths of an inch. *(See the Plate.)* They are then let half an inch into the barrel, one upon every other square or side. The middle line of the whelp is to be at right angles from the said square, that they may each be equidistant, fixing the heels of the lower whelps so that they may let into the pall-rim one inch and a quarter, and the heads, or upper ends, may let in one inch into the underside of the trundle head. The upper whelps are let in similarly to the lower whelps, and their heels so fixed as to be one inch above the upperside of the deck partners, with the heads let up one inch into the underside of the drumhead. They are fastened, as they are let in, by a treenail driven through the surge; but are afterwards farther secured by bolts, one bolt being driven above the surge, and one below it. When the capstan has six whelps, the bolts drive through from each whelp to its opposite one; but, when only five, the bolts may be driven nearly the same as shewn in the plan of the pall-head, &c. Fig. 4. or clinched upon the opposite square. The number of whelps seems to be optional, but it is certain that five whelps make the greatest angle, consequently the less strength will be required to hold on.

The chocks are sawed out of oak plank to the thickness given in the Table of Dimensions, and shaped as in the plate. *(See the Plate.)* The chocks at the heels of the lower whelps are the thickest, and are bolted to the barrel in the middle as in the plate, and the pall-head is bolted to them. The upper chocks are kept about one inch above the surge, and bolted through the middle. A middle chock, placed equally between the former, is sometimes, though seldom, used.

The lower chocks, excepting the pall chocks, at the heels of the upper whelps, have their undersides kept up four inches from the lower end of the whelps, and the upper chocks about one inch above the surge, shaped and fastened as those on the lower whelps. The pall-chocks are placed about three quarters of an inch above the heels, and fay close up to the chock above, and are kept four inches within the front of the whelps; the ends are nailed, and a small bolt is driven in the middle. All the chocks, excepting the pall-chocks, tail into the sides of the whelps, as shewn in the plate.

The lower end of the barrel is cut off square to the underside of the pall head, which is kept up about three-fourths of an inch above the pall rim, allowing for the iron plate and shoulder, or necking of the spindle, as may be clearly seen in the plate.

The iron spindle may be now let up into the lower end of the barrel as far as the shoulder. Its axis is to stand correctly with the centre of the barrel prolonged. Over the shoulder of the spindle is let on an iron plate that is bolted upwards with four bolts. The heel of the barrel is then reduced to the size of the iron plate, and an iron hoop driven on over all. A bolt is next to be driven through the barrel, at the upper end of the spindle, as shewn in the plate.

The pall-head is composed of two semi-circular pieces of elm, sawed to the given size in the Table of Dimensions, then trimmed straight and out of winding, and fayed close at the joints. Iron circular plates are let in their thickness, about one inch and a half within the edge; one on the upperside and one on the underside, and bolted through with twelve bolts, as shewn in the plate, observing to keep these bolt holes clear of the pall and slip bolts. The pall head is next let on the heel of the barrel, and one inch and a quarter up the heels of the lower whelps. It is then bolted upwards, through the lower chocks, with one bolt on each side of the bolt in the chocks. The whole may be more clearly understood by referring to the plan of the pall head, &c. Fig. 4. in the plate.

The trundle head is made of four semi-circular pieces of elm, sawed to the given size in the Dimensions, then trimmed straight and out of winding, fayed close together at the middle and joints. The joints cross each other at right angles. The holes for the bars, ten in number, are next set off to the size given in the Dimensions, and are cut out nearly through. Each piece is then let on and fayed to the barrel, the lower pieces admitting the head of the whelps up one inch. The bar-holes are then cut through to the barrel. The partners being large enough to admit the pall-head to pass in between them, the trundle head may be fastened thus ; an iron circular plate is let in its thickness, about one inch and a half within the outer edge on the upperside, and bolted through with one bolt between every bar-hole, as in the plan of the trundle-head in the plate. It is then bolted to the barrel or fastened to the upper chocks as the drumhead.

The upper or drumhead is made of four semi-circular pieces of elm, sawed to the given size in the Table of Dimensions. The upper pieces to be about one inch thicker than the under ones. They are trimmed and put together similarly to the trundle-head. On the upper end of the barrel is trimmed a square tenon, three-fifths of the size of the barrel, and long enough to let up about two inches into the upper pieces of the drumhead. Over the tenon is driven an iron hoop, about five inches broad and three quarters of an inch thick, let in flush, as represented on the plate.

The lower pieces of the drumhead are fayed and let on to the barrel and heads of the whelps one inch ; the upper and lower pieces are then connected together by a circular iron plate, let in its thickness on the underside, about one inch and a half within the outer edge, and bolted from the upperside with one bolt between every bar-hole. The bolts are saucer-headed, and are clinched upon the plate beneath. See Fig. 2, or plan of the drumhead.

A circular cap of elm, about one inch and a half thick, and the diameter of the size of the tenon, is fayed and nailed down over the centre of the drum-head. See Fig. 1, on the plate.

Holes are bored through the drum-head, about four inches within the edge, in the middle of each bar-hole, to admit a pin, which is fastened with a chain and staple near its respective bar-hole. These pins are to confine the bars on their places.

The drum-head is confined to the barrel by bolts that are saucer-headed, and forelocked on the undersides of the upper chocks with one bolt through every other chock. See Fig. 1, on the plate.

The YOKE may be next fitted. It consists of five muntins ; one fayed against every other square on the barrel, below the partners. Each muntin is to be of the size given in the Table of Dimensions, hanced away from the middle of the length to three inches thick at the head, then thirded and bearded in front a full quarter of an inch. The heels are stepped down in the trundle-head, as in Fig. 1. in the plate, and the heads reach upwards within an inch of the underside of the upper deck-partners. The muntins are fastened, at the upper parts, by a screw cut eye-bolt that screws into the barrel.

Between the muntins, at their heads, is let in a collar fayed to the barrel; the ends tail into the sides of the muntins, and are bolted or nailed to the barrel, as in Fig. 1. in the plate.

Capstans in East India ships are connected together at the partners by an iron spindle, having two shanks, one let up into the upper barrel similarly to that in the heel of Fig. 1. and the other shank let into the lower barrel. Each is secured by a large iron cross, let in over the spindle and into the ends of each barrel; being, also, farther secured by an iron hoop about five inches broad and three-quarters of an inch thick, driven on over all. See Fig. 10, in the plate.

The step and partners being fitted, and the iron rim let down horizontally to the axis or middle line of the barrel, the capstan may be hove on board and let down into its place, and the iron palls fitted and bolted as at Fig. 1. and Fig. 4. in the plate. Behind the pall bolt is let in an iron plate, to keep the pall from wearing the wood. Observe to fix the palls so that they swing clear of the whelps.

Slip bolts, as Fig. 8, to keep the palls up occasionally, are let into the pall-head, with iron plates, about three or four inches from the end of the palls, and so placed as to take the ends of the palls either way. Or, iron straps, with a hinge, as Fig. 9, to spread out occasionally, whereon the pall may lie. These are let flush into the pall-head, and fastened with screws.

The iron rim may now be bolted down, with tarred paper under it. The bolts have counter sunk heads, and are driven through the rim and step as at Fig. 4. and clenched underneath. Between the bolts, within the pall groove, are fitted pieces of elm, about one inch and a half thick in the middle, hanced away thence to half an inch at each end, and nailed through the holes cast in the rim to receive them. They prevent the palls in falling from making a noise, and they fall the more easily on wood. Holes are cast on the outside of the rim, one at the sides of every pall stop, that water may not lodge in the groove.

The partners are fitted as represented in Fig. 5. in the plate, to rabbet on the coamings, and bolted through with saucer-headed bolts, two in each piece at the ends.

In large ships the fore-jear capstan is fitted so as to lower occasionally out of the way of the long boat, &c. In this case it has partners fitted on the lower deck similar to those represented by Fig. 5, into which is let up a shifting step, as in Fig. 6, supported by a pillar and two ledges, in such a manner that the whole may be taken away, and the capstan lowered, to work in a step provided for it on the orlop.

2. OF WINDLASSES. *(See Plan of the Windlass, Plate 7.)*

THE body of the windlass is octagonal, and is tapered from the middle to the ends to the given Dimensions. It is sawed from good oak timber, and the length between the cheeks is often in one piece. But, when fitted with an iron axle or spindle in the middle, as Fig. 12, in the plate, it must be in two pieces. The ends without the cheeks are mostly fitted, as shewn in the plate, with an iron hoop driven over each end. The spindles are very accurately let into the ends and middle of the body, that the axis of each may exactly agree in a right line. A bolt is driven through the body of the windlass and each end of the spindle. On each end of the body is let on and bolted a pall-hoop with teeth, as shewn, Fig. 11, on the plate. The palls, which are of iron, are fixed against the aftsides of the pall-bitts, and fall into the teeth or notches of the pall-hoops, so as to prevent its turning backwards when charged by the effort of the cable, &c. at every two or three inches, as represented. Holes are then mortised along the middle, to admit the handspecs, and each square of the body is covered with elm or fir facings between the cheeks, on the working side in particular. It is then suspended by its axles or spindles either in brass rhodings, as Fig. 13, or in brass gudgeons, Fig. 16, which are bolted into a frame of oak timber called the cheeks. The cheeks are let down through the deck, and bolted to the pall-bitts, as shewn by Fig. 11.

There are other methods of fitting windlasses, but this we recommend as the best.

3. DESCRIPTION OF AN IMPROVED CAPSTAN OR WINDLASS. BY CAPTAIN THOMAS HAMILTON, OF THE ROYAL NAVY. *(See Plate C.)*

The intention in the present instance is, to demonstrate the form that a capstan should obtain, relative to the friction of the messenger when weighing anchor.

It is generally known that, in ships of war, when heaving at the capstan, with but little strain or resistance, there is a difficulty to hold on the messenger; and, on the contrary, when heaving with a great strain, it is often found necessary to slacken the messenger to let it surge or rise up the whelps of the capstan.

To use mechanical language, the surge or power to prevent the descent of the messenger with three turns and a half round the capstan, is too great for the friction when applied to little comparative weight or strain; and the surging power is too little for the friction, when applied to a great weight or strain.

The surge of the capstan is the angle from the perpendicular that the outline of the whelps make; and, in our capstans, it is about 9½ degrees uniformly from top to bottom, the outline of the whelps being straight. It follows that the less that angle is, so will the surging power be proportionally diminished, and conversely increased.

To counteract the surging power, the number of the whelps have been reduced from six to five, forgetting that the friction or descending power is increased in the same ratio in which the surge or ascending power is diminished; hence the use of lifters, rollers, &c.

N. B. The lifters which are ordered for the use of the navy are, upon an average, not less than £.20 expence for each capstan.

Four powers relative to the friction may be considered as belonging to the form or figure of the capstan, two of which may be called ascending powers, and two descending powers.

1st. Reducing the angle of the whelps, or approaching a cylindrical form, gives the greatest descending power. (Fig. 1. in the Plate).

2nd. Increasing the friction, by reducing the number of whelps, gives the second descending power. (See Fig. 2.)

3d. Increasing the angle of the whelps, or deviation from a cylinder, greatest ascending power. (See Fig. 3.)

4th. Adding to the number of whelps, or approaching a circle, second ascending power. (See Fig. 4).

In this plan it will be perceived that the two descending powers are applied to the upper part, and the two ascending powers to the lower part, of the capstan, and may be altered till the just angle of the surge is attained; although there is no doubt that the present angle is very near the truth, and it was found quite sufficient in the trials made in his Majesty's ship Argo, where twice a very great strain never caused the descent of the messenger an entire turn round the circular part of the capstan.

The following copy of a letter, from Commodore Hallowell, an officer fully competent to judge of the subject, will convince those, who are ignorant of mechanics, of the advantage to be derived from adopting the proposed form for either a capstan or a windlass, and save much expence, vexation, and probable mischief.

COPY OF COMMODORE HALLOWELL's LETTER TO THE COMMISSIONERS OF THE NAVY.

"His Majesty's Ship Argo, in the Downs, Oct. 31st, 1802.

"GENTLEMEN,

"ON the first trial made at Long Reach with our capstan and roller, when unmooring, I observed the roller to be of no use, as the messenger never required its assistance; I therefore ordered it to be removed, and, in repeated trials made between Long Reach and the Downs (having anchored six times), I am perfectly satisfied that the roller is useless with such a capstan as is filled in the Argo, which is nothing more than the old one with the lower part made more obtuse, and filled up circular by the chocks, and the upper part more perpendicular in the sides, and open. The alterations in the common capstan may be made without any expence, farther than the men's time employed in reducing the upper part of the surge, and putting the filling pieces to the lower part, and I am certain will be approved by every person who tries them. The rollers will be found of great service where capstans of the common form are used, and, in that case, the stantion of the roller should not be so high as the one fitted in the Argo, but just of sufficient length to allow the roller to traverse clear of the deck, which would give more room for the turns of the messenger round the capstan, and make the support of the roller greater. But the expence, and occasion for them, will be totally avoided by the trifling alteration being made in the capstan.

"I am, &c.

"BENJAMIN HALLOWELL."

REFERENC TO THE FIGURES IN THE PLATE.

Fig. 1, Greatest descending powe.

Fig. 2, Second descending power.

Fig. 3, Greatest descending powei

Fig. 4, Second descending power.

Fig. 5, A, capstan as usually mad, 9° 30′ angle of the surge. B, as fitted in the Argo. c c, open as usual. d, d, filled up with th chocks circular, making the lower part nearly a truncated cone. f f, a tangent to the arc g g. gg, arc of a circle to the chord h h and tangent f f. h h, outline of the whelps usually made, and chord to the arc g g, as altered in his Majesty's ship Argo.

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§ 3. DESCRIPTION OF A LAUNCH, AND EXPLANATION OF THE METHOD OF LAUNCHING. *(See Plate 9).*

The launch of a ship, or machinery by which she is safely conveyed into the water, after she is completely built, is a grand piece of mechanism, and requires every consideration: as, in the first place, to ascertain exactly with what declivity the ways may be laid, which should be as great as possible, or according to the depth of water wherein the ship is to be launched, and according to what height is required for laying the ways, so as to keep her fore foot from striking against the groundways. It wil here be necessary to allow about four inches for the settling of the ship in launching, more or less, according to its size and dependence on the ground. The planes should always cross each other, where possible, from one-eighth to one quarter of an inch, in every foot, in length, that is to say, the plane made by the surface of the sliding planks should increase so much more in their declivity than the plane made by the surface of the blocks whereon she was built. The plane of the sliding planks being laid as nearly to a straight line as possible fore or aft, and rather curving upwards. We shall here subjoin an account of a launch, as laid for a seventy-four gun ship.

Height from the upperside of the groundways to the underside of the false keel; afore, two feet eight inches; in midships, two feet three inches; abaft, two feet eight inches and a half.

Height from the upperside of the groundway to the upperside of the sliding planks; afore, three feet one inch; midships, two feet four inches and a quarter; and abaft, one foot ten inches.

Spread of the bilgeways, ten feet.

After end of the bilgeways, afore the aftside of the stern-post, twenty-three feet.

From the aftside of the stern-post to the end of the slip, one hundred and sixty feet.

The method of launching with spurs, formerly practised, is now become almost obsolete, although it has very lately been practised in some of his Majesty's yards; we shall therefore say but little of that method, but speak the more fully on the method now generally practised.

According to the old method, besides the stoppings-up, which we shall describe more fully hereafter, three spurs were placed forward, on each side; the foreside of the foremost spur being fixed at four feet four inches from the fore end of the bilgeways, and the others at about four feet distant from each other. In addition to these, was a driver forward, on each side, similar to a spur, but standing on the fore end of the bilgeways in a fore and aft direction. Towards the after end of the bilgeways were four spurs on each side, the aftside of the after spur being at four feet six inches from the after end of the bilgeway. At the head and heel of each spur three bolts were driven, each of one inch and a half diameter, and forelocked inside.

The poppets were of fir timber, two feet two inches athwartships. Ten were fixed forward, and thirteen abaft.

The oak dagger-planks and fillings under them were three inches in thickness.

The daggers were of fir, each in length forty feet; in depth, one foot; and nine inches thick. The fore daggers were seven feet above the sliding-planks forward, and ten inches above them at the after end; with an oak and fir dagger within and withoutside of the poppets afore and abaft.

The ribbands on the outside of the bilgeways were eight inches square; and the play of the ribbands, clear of the bilgeways, was two inches and one quarter.

The dog-shores were of oak; in length six feet six inches, and eight inches square. The foremost end of the dog-shore above the sliding-plank was one foot one inch; and the fore end was cut off two inches and a half under from a square, and cased with an iron plate.

Each of the bilgeways was one hundred and forty feet in length, two feet six inches broad, and two feet four inches deep. They were made with six decayed bowsprits, and had five loads and thirty feet of four-inch East-country plank for the soles, with three loads of three-inch plank for lining the sides.

Bolts, of one inch diameter, seventy-four in number; and nails, of seven and eight inches long, six hundred weight two quarters and nine pounds.

On the plan of the forty-gun frigate, Plate 9, is represented the modern mode of launching, to this plate the reader is therefore referred; as upon it may be seen the plan, elevation, and section, of the ways, &c.

The platform on each side, made by the blocks and sliding planks, is the first thing, as we have before observed, to be erected. Therefore, the spread of the bilgeways, which is about one-third of the main-breadth, more or less, according to the shape of the body, and the declivity, being determined, blocks are laid very nearly together, so that their uppersides shall form a straight line fore and aft, and an horizontal surface athwartships, to the height of the undersides of the sliding-planks.

The sliding-planks, which should be of oak, are next fayed close down upon the blocks, the butts giving shift to each other, and snaped. The thin part of the snape, on the upperside, is always placed aft; so that the bilgeways may slide over without the possibility of catching. The nails, by which they are fastened, must be punched down one inch below the surface.

The sliding-planks must be broad enough to receive the bilgeways, and the ribbands outside them, at least.

The bilgeways may be now hove up upon the sliding-planks, and placed under the bilge, to their intended spread, parallel to the middle line of the keel; the after ends reaching at least as far aft as the mizen-chains. The stoppings-up are then to be provided, which may be thus: Upon the upper surface of the bilgeways may be fayed a thickness of plank, or thickstuff, all fore and aft; and, above that, an opening, of five or six inches, preserved for the slices next above. In the midships, as far as is convenient, may be fayed a thickness of fir or oak plank, to the shape of the bottom; the undersides being kept parallel to the upperside of the plank below. In the same manner may the stoppings-up be continued, afore and abaft, by solid pieces of fir, oak, or elm, till the shape of the bottom would require them so deep that poppets, or upright pieces of timber, must be fitted, as represented in the plate.

Over the heads of the poppets is fitted an oak plank, which is bolted, or nailed to the bottom; the heads of the nails should be made very large, that they may be drawn out when the plank is ript off. Over this plank and the stoppings-up, till approaching the flat part of the body, cleats are nailed as a further security, to prevent the heads of the poppets from flying out. A cleat is likewise nailed fore and aft, against the heads of the foremost and aftermost poppet. Sometimes the poppets are set up with slices, as shewn in the draught, or are driven in tight under the bottom with a long spar or battering-ram. Then, to steady and keep the poppets firmly together, a dagger is faced on at their heads, and one towards the heels, which are securely nailed or treenailed to each poppet.

The ribbands are now to be nailed and shored along the sides of the bilgeways, leaving about two inches room or play from the side of the bilgeway. The foremost piece of ribband is generally of oak, and is coaked down upon the sliding-planks; against which, and the cleat on the side of the bilgeway, is fixed the dog-shore, in an inclined position, and so supported by a small piece underneath called a trigger.

When the ship is to be launched, the whole launch, thus fitted, is generally taken down, and the bilgeways canted out. Then the uppersides of the sliding-planks are paid with a thick coating of tallow and oil, into which soft soap is well rubbed. The bilgeways are then canted in, and all the launch fitted up as before. At the time of launching, the greater part of the shores may be taken away, and the ship set up as firmly as possible, by a great number of men employed in driving in the slices all fore and aft, and on each side.

As the tide now advances, the lower part of the slip should be paid with a thick coating of tallow and oil. The after blocks under the keel may be then split out and cleared away; the launch and the skeg-shores fitted; and so on, splitting and clearing out all the blocks, in a regular manner, till you come forward to the number of blocks intended to launch with, which may be four or five. The caps or upper pieces of these blocks should be chiselled or wasted away at their lower edges aft, and on their upper edges on the foreside. Then, when the tide has flowed so high that there is plenty of water, the dog-shores should be knocked down, each falling instantly. Then the screws, planted forward and against the bilgeways, may be hove, and the blocks, if she hangs, gradually wasted away till the ship starts.

That the dog-shores may fall at one instant, a contrivance has been raised by means of two large pigs of iron ballast, &c. one on each side, to slide down a shoot erected over each dog-shore. Each pig of ballast to be suspended by a rope. The two ropes may be spliced into one, and lead down forward to any convenient place, where the builder, or person having the charge of the launch, may cut the rope with a sharp chisel, &c. in an instant: then will the violence of the blow from the ballast have the desired effect.

To prevent the bilgeways from spreading, they have been lashed under the keel by having large ring-bolts forelocked through the bilgeways, one on each side in the middle, and one towards each end. Several turns of lashing are then passed through the rings, and hove taught under the keel: then, that the bilgeways may be separated when the ship is afloat, a line or small rope is made fast to each forelock that belays the ring-bolts, and leads up into the ship; by which means the forelocks are drawn, and the lashings, of course, become slack.

Launching shores are only used in the Royal yards; as, in private yards, all the shores are taken away some time prior to launching. The number is, in general, six or more on each side, close aft. Their stations at the heels being determined, they may be squared over to the foot-wharf of the slip from the middle line of the keel: lines may thence be looked upwards to the underside of the wale, square from the sliding-planks for their stations at the head; observing, that those lines represent the middle line of the shores if they taper much. Over the heads of the shores is fayed a plank, which is well nailed and cleated. Formerly, the heels were secured to the slip, and the shores cut away; but, lately, the heels have been secured by cleats, which are ript up, and the shores driven away. These shores are all taken away before the dog-shores are knocked down; but there are four or five others close before these, and they may rather stand with the ship, and forsake her as she advances in launching.

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§ 4. OF THE FIRE-SHIP AND BOMB-VESSEL.

As these vessels differ very materially, in their internal construction, from all others, it becomes necessary here to subjoin a brief description of them.

The FIRE-SHIP is, generally, an old vessel, peculiarly fitted up, and having its greater part filled with combustible materials. It is fitted with sheer-hooks, to the yard-arms, and grappling irons, for the purpose of hooking and setting fire to the enemy's ships in battle, &c.

As there is nothing materially different in the construction of fire-ships, excepting what relates to the fitting of that part of the ship where the combustibles are inclosed, and the apparatus by which the fire is instantly conveyed from one part to another, and thence to the enemy; it will be here only necessary to describe the fire-room, and the instruments that are used to grapple the ship or ships intended to be destroyed.

The fire-room is between decks, and is limited at the after-part by a bulk-head abaft the main-mast, from which it extends quite forward as represented in the draught and plans of the fire-ship, Plate 17. The train inclosed in this apartment is contained in a variety of wooden troughs, which intersect each other as shewn in the plans and midship section. These are supported, where necessary, by cross-pieces and stantions.

On each side, are six or seven scuttles, about eighteen inches long and one foot deep, having their lids to fall or open downwards as shewn in the midship section.

Against every scuttle is fitted an iron chamber, which, at the time of firing the ship, blows out the scuttle-lid, and opens a passage for the flame. Immediately under the main and fore shrouds is fixed a wooden funnel, whose lower end communicates with a fire-barrel. Between the funnels, which are likewise called fire-trunks, are two scuttles through the upper deck, as shewn in the draught, plan, and midship section. The flame, passing through the funnels, is conducted to the shrouds; and both funnels and scuttles have caps, closely fitted over in rabbets, with lead or canvas nailed close over them, to prevent any accident happening from above to the combustibles laid below.

The scuttles through the sides and decks not only communicate the flames to the outside and upper works of the ship and her rigging, but likewise open a passage for the inward air, confined in the fire-room, which is thereby expanded, so as to force impetuously through those outlets and prevent the blowing up of the decks; which must, of necessity, happen, from such a sudden and violent rarefaction of the air as will then be produced.

In the middle of the bulk-head is a door, through which are leading troughs, whose fore ends communicate with another trough within the fire-room laid close to this opening; whence it extends, obliquely, through the after-hatchway to the sally-port, as shewn in the draught and plan. At the time of firing either of the leading troughs, the flame is immediately conveyed to the opposite side of the ship, whereby both sides burn together.

The BOMB-VESSEL, being a ship particularly calculated for throwing bombs into a fortress, is, of course, constructed with remarkable strength, according to the plans exhibited on Plate 18, and is furnished with all the apparatus necessary for bombardment.

To facilitate the use of the mortar, in this vessel, it is placed in a solid carriage of timber, called the bed, whose different parts are strongly bolted together. By means of this it is firmly secured in its situation, so that the explosion of the powder may not alter its direction. In the middle of the upperside of this carriage, as represented on the plate, are two semicircular notches to receive the trunnions; over these are fixed two very strong bands of iron, called the cap-squares, the middle of which is bent into a semicircle, to embrace the trunnions, and keep them fast in the mortar-bed. The cap-squares are confined to the timber-work by strong pins of iron, called the eye-bolts, into whose upper ends are driven the keys, chained beneath them. On the fore part of the bed a piece of timber is placed transversely, upon which rests the belly of the mortar, or that part which contains the chamber. The elevation and plan of this piece, which is called the bed-bolster, and used to support and elevate the mortar, are represented in the plate.

These beds are placed upon very strong frames of timber, which are fixed as on the plate. They are securely attached to the bomb-beds, by means of a strong bolt of iron, called the pintle, passing perpendicularly through both, and forelocked underneath. Thus the pintle, which passes through the hole in the centre, serves as an axis to the bed; so that the mortar may be turned about horizontally as occasion requires.

For all the dimensions of a bomb-vessel, see the Table of Dimensions hereafter; particularly folio 18, wherein a description of many essential particulars may be found.

CHAPTER VII.

MISCELLANEOUS OBSERVATIONS ON IMPROVEMENTS AND PROJECTED IMPROVEMENTS; INCLUDING SOME INSTRUCTIONS AND REMARKS UPON SUBJECTS IMMEDIATELY CONNECTED WITH THE PRACTICE OF NAVAL ARCHITECTURE.

§ 1. EXPLANATION OF A NEW METHOD PROPOSED FOR THE FRAMING OF SHIPS, AND OF THE BEST MODE OF ADOPTING IRON FASTENINGS IN THEIR CONSTRUCTION.

It is certainly most reasonable that, in the construction of ships, the whole frame should be firmly connected together previous to any plank's being brought on (as the planking should only be a collateral security); and, in that state, its component parts should have an equal share of strength in proportion to the resistance.

According to the present mode of building, timber of equal shift with that which composes the frames or bends is used for the intermediate or *filling* timbers; and these are loose, or in nowise connected together, until the plank is brought on.

It is therefore proposed that, when the ship or vessel is complete in her frames or bends, tiers or ranges of oak scantling, eight or ten inches deep, and in and out what the frame is moulded, shall be tailed in, from frame to frame, at the range of each deck at the side, so that the beams may lodge thereon; and, to have, also, one tier or range below, as in Fig. 5. Plate 8.

The beams are to come through within one inch of the outside of the timbers, and tail thereto, as in Fig. 7. Thus the beams will have two advantages; the impossibility of ever working off the clamps, and longer duration, as the ends will be much less liable to rot than by the present methods.

Straps of iron, about four inches broad, or according to the size of the vessel, may be then fayed and bolted between each frame, and through the fore and aft pieces, as shewn in Fig. 5, and 7, with as many bolts through the ends of the beams as can be conveniently placed: thus would the whole frame be connected together.

By these means the filling timbers would be much shorter, consequently less expensive, and may be let in with a tenon at their heads and a lap at their heels into the fore and aft pieces.

After the plank is worked, the beams and sides may be farther secured by hanging knees; *as lodging knees would be useless.* Thus, let a large chock, as thick as the sidings of the wooden hanging knees, and as broad at the upper part as it will hold (such pieces may be obtained from the butts of large slabs or otherwise), as represented in Fig. 6. Such chock is to be fayed against the side of the ship and side of the beam, and bolted with six bolts, as shewn in Fig. 5. and 6. As the chock will not work broad enough to take the beam-arm of the knee, let an ekeing be fayed on to it, as shewn in Fig. 6. and 7.

Then, an iron hanging knee, as in Fig. 6. may be let in flush, and bolted as there represented. This sort of iron hanging knee will have two superior advantages; that is, it will have no shut in the crown, but need only be made from a stout iron, flat, turned round at the crown or shoulder, consequently much stronger; and, secondly, it will hold much more than others; because, as the bolts are driven fore and aft, they cannot draw; neither, by being let flush in the chock, will they have any tendency to work loose.

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§ 2. OBSERVATIONS ON THE MODE OF IMPROVING THE NAVY: ABSTRACTED FROM A LETTER ADDRESSED, IN THE YEAR 1796, TO THE COURT OF DIRECTORS OF THE HONOURABLE EAST-INDIA COMPANY, BY THE LATE GABRIEL SNODGRASS, ESQ. SURVEYOR TO THE COMPANY.

In the first place, I take the liberty of asserting, (and from experience,) that the East-India Company's ships, as now constructed, are the first and safest ships in Europe. In support of the assertion which I have made in favour of the construction of those ships, I beg leave to state that, of the ships built and repaired under my inspection, from the year 1757 to 1794, making in all 989, there was only one, the Earl of Chatham, which was supposed to have foundered. If the improvements adopted in those ships were extended to the Navy, much labour and expence would be saved to the nation.

Upon that idea the following remarks are founded; but, before I proceed to enumerate the particular circumstances which render the Company's ships superior to our ships of war, I must be permitted to remark, with deference to the opinions of the persons employed by Government in the department of ship-building, that radical errors appear to prevail respecting the article of timber.

In the first place, a much greater quantity of rough timber than can be necessary, is kept in store; for, I must contend, that a stock sufficient for one year's consumption would equally serve the purposes to which it is at present applied in any of his Majesty's dock-yards.

No ship was ever yet built entirely with timber that had laid to season three years, two years, or even one year; consequently, that part of the ship which was formed of the most unseasoned wood must be expected to decay first, and thus a progressive decay in the several parts of the ship subjects her to the necessity of continual repairs, at an immense expence, and to the great detriment of the service.

A second error is in the preparation of timber for service. Upon this, and upon the other point above mentioned, I cannot submit better information than the following:

The practice of keeping three years stock of timber, thickstuff, plank, &c. in his Majesty's yards, is so obviously destructive of timber in general, and so extravagantly expensive, that its having continued so long is next to a miracle.

Rough timber, piled together in such vast quantities as is practised in the King's yards, and to remain in that state for three years or more, must certainly receive much damage; but what proportion of it may be thereby rendered unfit for ship-building I cannot exactly determine.

All converted timber, thickstuff, plank, &c. should be placed under cover, where there is a moderate current of air, as soon as it is received into the yards.

All timbers, designed for ships' frames, should be contracted for to be served into the yards ready converted to their respective moulds, and the ships to be put on the stocks and completely timbered in a certain time, and to have a shed built over them (to be included in the said contract), and to remain in that state to season, during pleasure, or until wanted, when each ship should be completely finished by another contract. All the beams, knees, thickstuff, plank, &c. should be provided as soon as the ship is in frame, and placed under cover, so as to have the same seasoning. All thickstuff, plank, &c. that requires to be boiled in the kiln *, if afterwards placed on racks, and burnt so as to exhaust the moisture occasioned by its being boiled, and also to bring it to its round, would be of great advantage to the ships.

In building ships, the plank of the bottom, inside plank, &c. should be partially bolted on, and all the treenail holes bored through, as soon as the plank is worked; but no treenails driven until the ship is nearly finished, or ready for caulking; also to have the treenails well seasoned, before they are driven, and made of the best oak in the kingdom †.

The Commissioners of the Navy, in answer to inquiries concerning the duration of ships of war, have given, as their opinion, that ships built in the King's dock-yards last, on an average, about fifteen years; and those built by contract, in the merchants' yards, about ten years. This difference they impute, among other causes, to the timber used in the dock-yards being better seasoned, and the ships a longer time in building; which last circumstance alone contributes greatly to their duration. The merchant-builders, being employed to build ships of war, only in cases of emergency, are often, from the urgency of the service, pressed by the Navy Board

* See the article Kilns, in Chap. I. Book I.

† However highly we may have appreciated the professional abilities of Mr. Snodgrass, we cannot but differ from him with regard to some of the foregoing particulars. First, with respect to keeping a certain quantity of timber in the naval or other yards, he cannot be correct. For, every one concerned in timber must know, that it is only to be obtained at certain times; and an opportunity missed cannot always be recalled. The naval yards, for several years past, instead of having too great a supply by them, have not had a quantity sufficient to supply their immediate wants. Again, it must certainly be allowed, that timber three years seasoned before it is used, would be much the better, and last longer. It would, also, be much better to season it before converted than in the frame.

The practice of letting the sap run before the tree is felled, for the purpose of stripping the bark, makes against the duration of timber, especially when time for seasoning cannot be allowed.

Timber piled and shedded over would remain so for seven years uninjured; and, when spread about the ground in its rough state, with the air passing freely between, it would continue so for four years or more, unhurt; nay, it would be the better for it.

And we can truly say, that, during a long experience, we never saw any useful timber rotting in his Majesty's yards.

to complete them in a shorter time than is specified in the contract; and, not having a sufficient stock of timber on hand, they are obliged, *at a short notice, to provide what is wanted, and to work it up before the juices are sufficiently exhausted to render it fit for use.*

Government should have twenty or thirty sail of line-of-battle ships, of seventy-four guns and upwards, constantly on the stocks, (under proper cover) nearly finished, or in such state that they may be launched in a short time, on any emergency; and should, under sheds, have ships built for the Navy in private yards, in time of peace; by which means the ships would last from eighteen to twenty years, instead of only eleven years and three quarters, which is said, by the Navy Board, to be the average duration of ships of the present Navy.

OF IMPROVEMENTS IN THE CONSTRUCTION.

By making the topsides of all the King's ships, in future, to tumble home very little, according to the plans represented in Plate 8, also by siding the timbers of the frame less, and moulding them more, would add strength to the ships, and lessen the consumption of timber*.

The principal causes of the frequent losses of King's ships at sea, in case of violent storms, or the ship's broaching-to, appear to me as follow, viz.

In the first place, the deep waist in those ships, and more especially in the frigates and sloops of war, which occasion them to ship a great deal of water on the main-deck.

Secondly, the ballast, water, and every thing in the hold, shifting and falling to leeward, from want of shifting-boards, and the pillars not being properly secured to prevent the same, whereby the ships are liable to become water-logged; and thus, before the hatches are sufficiently secured, they may fill and founder.

Captain Inglefield's narrative of the loss of the Centaur, of seventy-four guns, will clearly evince that not only small ships, but all ships of war, however large, should have shifting-boards in the hold, and the pillars better secured; and, as a further security from the guns doing damage, in case of their breaking loose, I recommend substantial coamings to all the hatchways, at least two feet above the decks, also thick pieces of oak in midships, between the hatchways, let down upon the beams, equally well secured, and of the same height above the deck as the coamings, which must prevent the guns from going farther to leeward †.

I am confident that, if all ships had firm and flush upper decks, in place of deep waists, as shewn in the Plate of Midship Sections, before mentioned, they would be far superior, not only as ships of war, but also in point of safety; as it would then be almost impossible (except through great neglect) for any ship to founder in deep water, even in the heaviest sea or the most severe storms. I feel myself so deeply interested in this subject, that I must take the liberty of referring to Steel's List of Ships lost or foundered at sea ‡, and I am persuaded that I

* See also our method, described in the preceding section, for framing the timbers.

† This would also add strength to the decks, if lapped under and connected to the head ledges.

‡ In Steel's Naval Chronology of the American War, and annexed to the official copy of Mr. Snodgrass's letter.

am rendering a service to the community by pointing out what I am certain would prevent those fatal consequences in future.

It is many years since the keels and stems of all the East-India ships have been rabbeted in the middle, which is certainly safer and better than having the rabbet so near the edge, as is the practice in the ships of his Majesty's navy.

The sterns of ships of war should have little or no rake, in order to give an opportunity of fighting a greater number of stern-chase guns, which cannot be done with safety where the sterns have a great overhanging, as is the case with the ships of his Majesty's navy. There should be strong dead-lights to their stern-windows, and no quarter-galleries, which are not only unnecessary in those ships, as when they are close-hauled they very much impede their sailing, but are also dangerous (particularly in small ships) in case of the galleries being carried away; neither should there be any scuttles through the sides, or their tillers under the gun-decks of any ship: there should be whole ports instead of half ports between decks, and no line-of-battle ships should work their cables on the lower deck*.

I am of opinion that all the ships of the present Navy (1796) are too short, from ten to thirty feet, according to their rates. If ships, in future, were to be built so much longer as to admit of an additional timber between every port, and if the foremost and aftermost gun-ports were placed at a greater distance from the extremities, they would be stronger and safer, have room for fighting their guns, and, I am persuaded, would be found to answer every other purpose much better than the present ships; and there would be no necessity of using long thickstuff and plank for a three-port shift in such ships, as a two-port shift would be quite sufficient.

The fore-masts of all the ships of the Navy are placed too far forward, from four to six feet; the ships are too lofty abaft, and too low in midships; they would be much better and safer, if their forecastles and quarter-decks were joined together; for, if they carry *two*, *three*, or *four* tier of guns, *forward* and *abaft*, they certainly ought to carry the same in *midships*, as it is an absurdity, and also a great injury to any ship, to load the extremities with more weight of metal than the midships; and no ships, however small, that have forecastles and quarter-decks, should go to sea with deep waists; they certainly ought to have flush upper-decks.

I would construct or form all ships so as to require as little compass *(alias* large *grain-cut)* timber as possible, and make use of no oak for orlop-beams, &c. or wherever I could substitute fir or elm, &c. with propriety, in the room of oak. I would likewise convert all the timbers in the ship as near to a square as possible, that no strength might be lost by reducing them too much the moulding way, which is too frequently done, to the great injury of ships in general; and I would also increase the thickness of the plank of most ships' bottoms, and rabbet the same, and diminish the inside plank in proportion.

About twenty-seven years ago I introduced four-inch bottoms to ships for the East-India Company's service, instead of three-inch bottoms, and there are ships of less than six hundred tons burthen, built for that service, with four-inch bottoms, also with sheathing of three-quarters of

* Here we must beg leave to differ; for the lower the hawse-holes are placed, consistent with convenience, the more easily will the ship ride.

an inch thick, and coppered as usual; whilst, on the contrary, there have been frigates of a thousand tons burthen, lately built for Government, in Merchants' yards, with three-inch bottoms, and a ship of eight hundred tons with a fir bottom only three inches thick; and there are ships of seventy-four guns now (1796) building in those yards of eighteen hundred tons burthen, with not more than four-inch bottoms, which ships, I presume, are intended to go to sea as usual, without any wood sheathing.

Out of the great number of ships that have been lost, from getting on shore, or striking on the rocks, there can be no doubt that many might have been saved if their bottoms had been thicker when originally built, and the old ships doubled with three-inch oak plank when they required considerable repairs.

It appears to me, that continuing the practice of *thin* bottoms tends to risk the loss of the ships and the lives of his Majesty's subjects, more especially if fir be taken instead of English, Quebec, or East-country, oak plank, which may always be procured. In my opinion, no ships of four hundred tons and upwards should have less than a bottom of four-inch oak plank; all ships of the Navy, of eight hundred tons and upwards, should have not less than five-inch plank; line of battle ships should have bottoms at least six-inches thick *; and all ships should have the addition of wood sheathing. The thickness of the inside plank of those ships may then generally be reduced in proportion.

The wales and inside stuff of those ships are much too thick, which occasions an unnecessary consumption of oak timber, as wales, &c. eight-inches thick, would be sufficient for the largest ships in the Navy, were the foregoing alterations adhered to, and their edges rabbeted so as to require little or no caulking. *(See Midship Sections, Plate* 8.*)*

Ships of the Navy are not sufficiently strong to carry the usual weight of metal: upon the whole they have plenty of timber, but are very deficient in iron to strengthen and connect the sides and beams together †, so as to prevent their working in bad weather or in long engagements, when they usually break many of the fore and aft bolts of the knees, and the ship spreads so as to leave the ends of the beams short of the sides. To prevent this, they should have iron hanging-knees (with a greater number of fore and aft bolts than is customary) to all the beams in the ship; also iron standards fayed to the decks (without sholes) between every port; and all old ships of the present Navy should have iron, instead of wood standards, and an additional iron hanging knee under every beam in the ship, where there is not a standard; and also to have diagonal braces fixed to them. I particularly recommend diagonal braces to be fixed from the keelson to the gun-deck clamps; six or eight pair of them well secured at each end with iron knees and straps, which would effectually prevent their straining and working in bad weather, in the manner they now do.

All bolts of the knees, breast-hooks, and crutches, should be driven from the inside and

* We are, however, fully of opinion, that it will be quite sufficient to give ships of 400 tons and upwards a three inch bottom, instead of one of four inches, as recommended by Mr. Snodgrass; of 800 and upwards, a four inch bottom, instead of a five inch; third rates, a five inch bottom; and 1st and 2d rates only, a bottom of six inches.

† See the proposed method of framing described in the preceding section.

clenched on the outside plank, and the bolts of all iron knees, standards, &c. should have stout collar-heads.

Iron may be used for hanging knees and standards to all decks, for all breast-hooks, (except the deck-hooks) riders, crutches, wing-transom and other transom knees, and for knees in general. I have had great experience of iron for many years, and am confident that it may be used for the above purposes in all ships of war, and other ships, to much greater advantage than wood; it being obviously impossible, by any means, to make a ship equally strong with wooden knees, &c.*.

It is more than seventeen years since I brought into use, for the East-India ships, round-headed rudders, (See Plate 20.) requiring no rudder-coats. Experience taught me how dangerous the old fashioned rudder-coats were, particularly in small ships of the Navy, many of which, I cannot doubt, have been lost from the sea having carried away their rudder-coat.

The round-headed rudders are now universally acknowledged to be much superior, in every respect, to the square headed rudders of the ships of the Navy; and I am very anxious that these should be introduced into all ships to be built in the King's yards, and provided for in the contracts made, in future, for ships of war to be built in Merchants' yards.

All ships' rudders should be short of the underside of the keel, from eighteen inches to two feet, and should be hung in the centre, and have a round head, to work in a circle, so as to require no rudder-coat; and of those ships that have no round-house, the rudder should run up, and steer with a yoke abaft the rudder-head, above the upper deck.

Cables are, in general, very much injured by small riding-bitts and cross pieces; and, more especially, from the fore part of the bitts and after part of the cross pieces not being made circular, or their edges rounded, when new. Seventy-four gun ships' bitts and their cross pieces are not more than twenty inches each, whereas those of the East-India ships are two feet, and the fore part of the bitts and the after part of the cross pieces are so rounded, that the cables cannot be in the least injured by them. Last year one East-India ship (the Woodford) had cast-iron rollers fitted to her bows, to ease the friction of her cables, in place of bolsters or naval-hoods †.

All scuppers should be of cast-iron, without having any lap on the deck, or spirkitting, as they could not then be broken by the working of the ship.

The heads and quarter galleries of all ships should be reduced, and also the great overhanging of the sterns.

No ship should ever have what is called a "thorough repair," or *any timbers* shifted. Instead

* We cannot recommend iron hanging knees, &c. (excepting standards) to be adopted in ships of war, in preference to those of wood, for several reasons already shewn in the course of this work. Iron knees may serve as a substitute, when others cannot be obtained; but, to say that iron knees are found to answer *better* than those of oak, must appear like an insult to mechanical knowledge: because four wood knees, well grown and fastened, will be found superior to seven iron knees of the best construction. It is, however, but justice to add, that the testimony of Captain Trollope, of the Glatton, which was built for the India service, with all her hanging knees of iron, had been two voyages there, and was one of those ships taken up on the emergency of Government in the year 1795; and, of that of Captain Lowis, of the Woodcot, which encountered a most dreadful storm, are certainly very favourable to iron fastenings.

† These were tried years ago in the Navy, and found to be more injurious than useful. EDIT.

of this, their bottoms and upper works should be doubled with three-inch oak plank, from keel to gunwale, and strengthened with iron knees, standards, and even with iron riders, if necessary; all of which might be done at a small expence, and ships so repaired would be stronger and safer, and be able to keep the seas longer, in the worst weather, than any new ships in all his Majesty's Navy *.

This measure would be the means of saving great quantities of valuable straight and crooked (commonly called compass) oak timber, which otherwise must be expended by giving ships thorough repairs; and it should be more especially adopted with respect to such ships as have their topsides of the absurd old fashion of *tumbling-in*, than which nothing can possibly be more extravagant and ridiculous; as many of the timbers must be much weakened by being cut across the grain; and such ships as have had a second thorough repair, must also be further weakened, as the timbers are always considerably reduced in the moulding way on each repair, and those timbers are originally much too slight: on the contrary, great advantages would be derived from having little or no tumble-home to the sides, as it gives more room upon deck, a greater spread to the shrouds, additional security to the masts, makes the ship stiffer, a much better sea-boat, and, in every respect, safer, stronger, and better.

It is a well known fact, that many ships have *each* cost nearly as much repairing, as two new ships, of the same dimensions and scantlings, would cost building: perhaps this has been done on an idea of saving timber, but certainly it is a great mistake.

I have made it a practice, for many years, to add iron knees under the beams to all old ships in the Company's service; and, of late years, to such ships as have made three voyages. I have frequently added an iron knee under every beam of the lower and middle decks, from the fore-mast to the mizen-mast, where there has not been a standard. If his Majesty's ship Centaur (although French built) and others that have foundered at sea, had been fitted in this manner, it would have prevented their sides from separating from the ends of their beams, and, consequently, might, in all probability, have prevented those ships from foundering.

Indeed, I am persuaded, that the loss of most of the ships of war, and even merchant ships, that have foundered at sea, has been occasioned by their having been insufficient in point of strength.

Whenever a ship is lost at sea, a strict inquiry ought to be made of the survivors, as to every particular, in order that the *cause* of such loss may be ascertained: the result of such inquiry should be made as public as possible to the eye of observation.

Inferior timber being generally used for framing ships and docks, it is not very material as to the quantity made use of; but, with respect to the mode of launching and docking ships in his Majesty's yards, I am of opinion, there is great room for improvement; and I beg leave to observe, that few things are so obviously absurd as the old method (which is at present practised in the King's yards) of launching ships on a curve line, with short bilgeways and slices under each end of them, and also with spurs; by which method it is impossible to launch any ship

* The former part of this paragraph is certainly proper and correct; the conclusion of it, however, bears evident marks of prejudice, and is, as certainly, the reverse. Edit

without *hogging*, and consequently injuring them more or less. To prevent ships from receiving such injury, in future, I would recommend, that their keels be put on blocks, of sufficient heights, so that the *ways* for launching them may be laid on a straight line, with a declivity of near an inch to a foot, for large ships, and of a full inch to a foot, for the smaller class of ships. To have bilgeways as usual. (But fitted without either spurs or slices, as all King's ships are docked after they are launched, to be coppered. A plank secured to the bottom, at both ends of the bilgeways, to prevent the heads of the poppets from flying out, would be safer and much better than spurs). In addition to the bilgeways, to have sliding planks, or ways in the middle line, to receive the keel, from about fourteen feet afore the stern-post; and, to be continued as low down as the launch is laid for the bilgeways, and of such a height as that the *fore-foot* may run safely over it, and of the same declivity as the sliding-planks for the bilgeways. By this method, it would be impossible that any ship should receive the least damage in launching; for, when the blocks are all split out from under the keel, the ship would be perfectly safe, and as well supported, all fore and aft, as when they were all under, and might remain in that state until the next spring tides, or longer, if it should be required, by want of water or any other cause.

The mode of docking large ships at Portsmouth, and the other naval yards, by heaving them an end on the blocks, with tackles, when there is not sufficient water to float them in; and also of raising them, with wedges and shores *, in order to shift their keels, false keels, &c. when required, is certainly very absurd, and the more surprising that it should have continued to this time (1796); when, by taking a view of the locks, &c. on the various inland navigations in this country, they would, at once, point out a more rational, and much easier method of docking large ships, and raising them on blocks of sufficient height for shifting keels, or doing any repairs that may be wanted, without the least difficulty, by filling the docks with water, to any height required, by means of a reservoir, sufficiently large for that purpose; which may be always supplied and kept full by a steam engine or otherwise, at very small expence, and to the greatest advantage.

If the foregoing alterations in the building and launching were put into execution for ships of war, I am certain that they would be *much stronger*, *safer*, and *more durable*, than the present ships of his Majesty's Navy; and that they would also be able to keep the seas, for years, without docking. I have no idea of a ship of war, that is properly built, *foundering*, or not keeping the seas in the *worst weather*.

The fewer ships that are built for the Navy, in future, not capable of mounting seventy-four guns and upwards, the better; as ships of sixty-four, fifty, and forty-four guns, *(upon two decks)* also small frigates, sloops, &c. consume vast quantities of oak timber, are maintained at great expence to the nation, and are by no means proportionably serviceable.

But I am of opinion, (contrary to the ideas of some gentlemen,) it would be for the interest of Government, and also for that of the East-India Company, if they were to have twenty sail of

* This objection is obviated by Mr. Seppings's plan of blocking ships, described in the next section, and now practised in his Majesty's yards.

ships built for the China trade *(when new ships are wanted)* that may be capable of fighting sixty-guns, with a cargo on board them *. They might carry eighteen pounder guns on their middle decks, and six or nine pounder guns on their upper decks; and, when deeply laden, would be able to keep their lower tier of ports open longer than any ships in his Majesty's Navy. Such ships being more defensible, would require a less number of ships of war to protect them, which would save the vast expence of convoys, and of ships being stationed in India, &c. in time of war: it would also be a great saving of oak timber, as the swift decay of ships stationed in India is very evident, and is a matter that ought to be particularly attended to.

I am farther of opinion that, if the Company were to carry on their trade, in general, in large ships, they would not be so destructive to the growth of oak timber as small ships; for, if two ships were to be built, of six hundred tons each, and one of twelve hundred tons, it would be found that the former (two) had consumed near three-fourths more, in *number*, of oak trees, than the latter; consequently, the small ships would increase the consumption of young growing timber trees, and tend greatly to prevent the growth and supply of large timber.

I have found, on inquiry, that oak timber, under forty feet meetings, has increased in price, since the year 1771, about fifteen shillings per load; whereas, timber of sixty feet meetings has increased only five shillings per load, which is a proof there has been a greater demand for small timber than for large; and, if the consumption of the former continues to be greater, it will (unless proper precautions are taken) ultimately cause a scarcity of the latter.

I would farther recommend that, whenever a peace shall take place, all those ships that were contracted for, or built for the East-India Company's service, and purchased by Government, should be returned to be employed in that service again; which would be the means of saving a great quantity of oak timber.

I am confident, that the surveyors of the Navy may form such bodies for line of battle ships as would answer equally well for trade in time of peace, and such ships may be lent out to be employed in the East-India Company's service as merchant ships †. This measure would not only save an immense consumption of oak timber, give further time for improving the King's forests, and prevent the ships from rotting in the harbours, but would also save the public the usual expence of repairs, and they may be returned to Government when required.

In my opinion, a great deal too much has been said in favour of French ships. I cannot, myself, see any thing worthy of being copied from them but their magnitude, they are, in other respects, much inferior to British ships of war, being slighter and weaker; in general, draw more water, and they likewise commonly exceed the old ships of the present Navy in the absurd tumble-home of their topsides. It must appear very extraordinary, that there are several line of battle ships and large frigates now building (1796) for Government from draughts, copied from those ridiculous ships.

* See draught of the East-Indiaman, Plate 20.

† Here we again differ. For those gentlemen, while uncontrouled, can give, and have lately given, several instances of their superior judgment in this respect; of which such proofs exist as to render any argument, which we could advance upon the subject, useless.

§ 3. EXPLANATION OF MR. SEPPINGS'S NEW METHOD OF DOCKING SHIPS.

Among other improvements, relating to shipping, which have been recently made known to the public, that of docking ships on the blocks, ingeniously contrived by Robert Seppings, Esq. master builder of his Majesty's yard at Chatham, is worthy of a particular description.

Formerly, ships docked for repair required considerable expence, time, and labour, to raise, lift, or support them, whilst the blocks were split out and cleared away from under the keel, in order to examine or replace whatever might require shifting. The expence was not only incurred by fixing a great number of additional shores, which consumed a great quantity of fir timber, but much labour and time were also required to perform the task; for each shore required a man to drive in the wedges necessary for lifting so weighty a body.

The present plan, of which the figures are represented on Plate 8, is superior in every respect, as it is not only simple in its operation, but perfectly safe and lasting in its duration.

Figure *a* in the plate, represents the upper block, formed of wood, and cased with iron, which is fastened on its upper and under sides as shewn by the ticked lines.

b, *b*, Wedges of cast iron.

c, Plan of the upper block, with an iron bolt through each end, by which it may be easily removed.

d, *d*, Plan of the wedges.

e, *e*, The lower block, cased with iron on its upperside, as ticked.

f, *g*, Plan and elevation of the battering ram, for driving the blocks in and out, as required. The ticked lines under the wheel, in figure *g*, represent iron plates, let in flush with the wood, to prevent its wearing; and the dark shade over the ends represent casings of iron for the same purpose.

By this plan no waste of timber will be made; for the ship being shored only to support her, the blocks may be readily removed by loosening the iron wedges *b b*, and removing the upper block *a*; which is easily done by means of the iron bolt at each end.

The lower block, *e e*, may be of any depth, according to what height the ship is intended to be brought in upon; or, according to any additional number of blocks which may be placed under it.

The blocks being placed as usual, that is to say, straight and out of winding, to the given height, and the ship settled thereon, the iron wedges *b*, *b*, may, where required, be driven in tight by the battering ram, and the ship will be lifted accordingly.

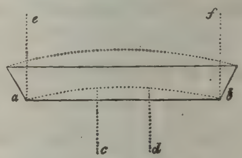
The ropes through the sides of the battering ram, marked *h*, *h*, *h*, *h*, are fixed in, that such additional strength may be applied as may be found necessary for driving in or out the iron wedges.

The experiment was first tried, in the year 1801, on the Canopus, of 84 guns, in Plymouth Dock; and it appears that, by this simple operation, forty men can, in twelve hours, perform as much as used, on the old principle, to occupy 300 men for nearly three days; and, although some ships, on the old plan, have settled from eight to ten inches, the Canopus, by this new method, settled not so much as half an inch.

§ 4. SOME REMARKS UPON A SHIP'S HOGGING; AND THE MEANS OF PREVENTION.

When it is said, that the pressure of water upon the immersed part of a vessel counterbalances its weight, we suppose that the different parts of a vessel are so firmly connected together, that the forces which act upon its surface are not capable of producing any change; for we may easily conceive that, if the connection of the parts were not sufficiently strong, the vessel would be liable either to be broken, or to suffer some alteration in its figure.

The celebrated *Euler* has supposed a vessel to be acted upon by several forces as in the figure *a b*, which, if acted upon by the forces or weight, *e*, *f*, acting, downwards, and *c d*, the pressure of the water, acting upwards, may be maintained in equilibrio, provided that the vessel has a sufficient degree of strength; but, so soon as it begins to give way, we see that it must bend in a convex manner, since its middle would obey the forces *c* and *d*, acting upward, whilst its extremities would be actually forced downwards by the forces or weights *e* and *f*.



Vessels deficient in strength are generally found in such a situation; and, since similar effects continually act whilst the vessel is immersed in the water, it has happened but too often that the keel has experienced the bad effect of a strain.

This case, which is called *Hogging*, has been seen in many vessels; and has arisen from want of strength in their component parts as well as disarrangement in the stowage.

Many long, deep, straight floored vessels, too slightly built, have been found to hog, owing to the great upward pressure of the water upon the broad part of the bottom; and it has been found that, the longer and larger ships are, the more easily have their bottoms bent or hogged, even when the stowage has been correct; and much more so when it has been unequally distributed towards the head and stern.

Ships deeply laden, with very heavy cargoes or materials nearly amidships, have, on the contrary, been sometimes found to *sag* downwards, in proportion as the weight of the cargo has exceeded the upward pressure of the water.

But, according to the present practice of building in Great Britain, these disadvantages are little to be feared; although, in a less advanced state of the art, they were frequently found in British vessels, and are still as frequently found in vessels of foreign construction; many of the latter being of too small scantlings and too slightly constructed. Even sharp built vessels of this country, upon the present construction, are seldom found to hog; and we presume that no vessel constructed agreeably to the Table of Dimensions and Scantlings, given hereafter, will be found to do so. But it is to be particularly observed, that these dimensions, with respect to the strength of the body, will not admit of diminution; and this observation is the principal object of the present remarks upon the subject.

If, however, the *relative* dimensions be changed; and, if the length be increased, as recommended in some cases, in order to produce an increase in the velocity, or if the ship is intended to be laden with very heavy materials, as lead, &c. the strength may be proportionably increased by enlarging the scantlings of the thick-stuff at the joints of the timbers, &c. and adding the braces, and bilge-keels as represented in midship sections, Fig. 1, and 2, in Plate 8. They may, likewise, be farther strengthened by additional keelsons.

§ 5. ON THE MEANS OF RECOVERING STRANDED AND FOUNDERED SHIPS.

1. AN ACCOUNT OF A METHOD FOR THE SAFE REMOVAL OF SHIPS THAT HAVE BEEN DRIVEN ON SHORE AND DAMAGED IN THEIR BOTTOMS. BY MR. WM. BARNARD, SHIPBUILDER, OF DEPTFORD.

(From the Philosophical Transactions.)

ON the shores of this island, distinguished for its formidable fleets and extensive commerce, and so particularly situated, there must necessarily be many shipwrecks: every hint by which the distress of our fellow creatures may be alleviated, or any saving of property made to individuals in such situations, should be communicated for their good. As the members of the Royal Society have it in their power to make such hints most universally known, I have been induced, from their readiness to receive every useful information, to lay before them a particular account of the success attending a method for the safe removal of ships that have been driven on shore, and damaged in their bottoms, to places (however distant) for repairing them; I hope, therefore, that they will excuse the liberty I have taken in presenting this to them. Should the Society honour me by recording it, it will make me the most ample satisfaction for my attention to it, and afford me the greatest pleasure.

On January the 1st, 1779, in a most dreadful storm, the York East Indiaman, of eight hundred tons, homeward bound, with a pepper cargo, parted her cables in Margate Roads, and was driven on shore, within one hundred feet of the head, and thirty feet of the side, of Margate Pier, then drawing twenty-two feet six inches water, the flow of a good spring tide being only fourteen feet at that place.

On the 3rd of the same month I went down, as a ship-builder, to assist, as much as lay in my power, my worthy friend Sir Richard Hotham, to whom the ship belonged. I found her perfectly upright, and her sheer (or side appearance) the same as when first built, but sunk to the twelve feet water mark fore and aft in a bed of chalk mixed with a stiff blue clay, exactly the shape of her body below that draught of water; and, from the rudder being torn from her as she struck in coming on shore, and the violent agitation of the sea after her being there, her stern was so greatly injured as to admit free access thereto, which filled her for four days equal to the flow of the tide. Having fully informed myself of her situation and the flow of spring tides, and being clearly of opinion that she might be again got off, I recommended, as the first necessary step, the immediate discharge of the cargo; and, in the progress of that business, I found the tide always flowed to the same height on the ship; and, when the cargo was half discharged, and I knew the remaining part should not make her draw more than eighteen feet water, and while I was observing the water at twenty-two feet six inches, by the ship's marks, she instantly lifted to seventeen feet eight inches, the water and air being before excluded by her pressure on the clay, and the atmosphere acting upon her upper part, equal to six hundred tons, which is the weight of water displaced at the difference of those two draughts of water.

The moment the ship lifted, I discovered that she had received more damage than was at first apprehended, her leaks being such as filled her from four to eighteen feet water in one hour and a half. As nothing effectual was to be expected from pumping, several scuttles or holes in the ship's side were made, and valves fixed thereto to draw off the water to the lowest ebb of the tide, to facilitate the discharge of the remaining part of the cargo; and, after many attempts, I succeeded in an external application of sheeps' skins, sewed on a sail and thrust under the bottom, to stop the body of water from rushing so furiously into the ship. This business effected, moderate pumping enabled us to keep the ship to about six feet at low water, and by a vigorous effort we could bring the ship so light as (when the cargo should be all discharged) to be easily removed into deeper water. But, as the external application might be disturbed by so doing, or totally removed by the agitation of the ship, it was absolutely necessary to provide some permanent security for the lives of those who were to navigate her to the River Thames. I then recommended, as the cheapest, quickest, and most effectual plan, to lay a deck in the hold, as low as the water could be pumped to, framed so solidly and securely, and caulked so tight as to swim the ship independent of her own leaky bottom.

Beams of fir timber, twelve inches square, were placed in the hold under every lower-deck beam in the ship, as low as the water would permit; these were in two pieces, for the convenience of getting them down, and also for the better fixing them of an exact length, and well bolted together when in their places. Over these were laid long Dantzick deals of two inches and a half thick, well nailed and caulked. Against the ship's side, all fore and aft, was well nailed a piece of fir, twelve inches broad and six inches thick on the lower, and three inches on the upper edge, to prevent the deck from rising at the side. Over the deck, at every beam, was laid a cross piece of fir timber, six inches deep and twelve inches broad, reaching from the pillar of the hold to the ship's side, on which the shores were to be placed to resist the pressure of the water beneath. On each of these, and against the lower-deck beam, at equal distance from the side and middle of the ship, was placed an upright shore, six inches by twelve inches, the lower end let two inches into the cross piece. From the foot of this shore to the ship's side, under the end of every lower-deck beam, was placed a diagonal shore, six inches by twelve, to ease the ship's deck of part of the strain by throwing it on the side. An upright shore, of three inches by twelve, was placed from the end of every cross piece to the lower-deck beams at the side; and one of three inches by twelve on the midship end of every cross piece to the lower-deck beam, and nailed to the pillars in the hold. Two firm tight bulkheads or partitions were made as near the extremes of the ship as possible. The ceiling, or inside plank of the ship, was very securely caulked up to the lower deck, and the whole formed a complete ship with a flat bottom within side to swim the outside leaky one; and that bottom being depressed six feet below the external water, resisted the ship's weight above it, equal to five hundred and eighty-one tons, and safely conveyed her to the dry dock at Deptford.

Since I wrote the above account, I have been desired to use the same method on a Swedish ship stranded near Margate on the same day as the York East Indiaman, and swim her to London. As this ship is about two hundred and fifty tons, and the execution of the business something different from what was practised with regard to the large ship, I hope it will not be thought improper to describe it.

As this ship's bottom was so much injured, having lost eight feet of her stern-post and all her keel, several floor timbers being broke, and some of the planks off her bottom, (so as to leave a hole big enough for a man to come through,) several lower-deck beams being likewise broken, and all the pillars in the hold broken and washed away ; I thought it necessary to connect, in some degree, the shattered bottom with the ship's decks, not only to support the temporary deck by which she was to swim up, but to prevent the bottom's being crushed by the weight of the ship when she was put upon blocks in the dry dock : to effect which, after I had put across twelve beams of fir, six inches by twelve, edgeways, one under every lower-deck beam of the ship, and well fastened them to the ship's side, I placed two upright pieces to each beam, of six inches by twelve, securely bolted to the sides of the keelson, and scored six inches under the ship's lower deck beams, and three inches above the beams of the temporary deck, and well fastened to each : then the deck was laid with long two-inch Dantzick deals, and well nailed and caulked ; the ship's inside plank was well caulked up to the lower deck. A piece of fir, of twelve inches broad and two inches thick on the upper, and four inches on the lower, edge, was well nailed to the ship's side, all fore and aft, and well caulked on both edges to prevent the side of the deck from leaking, or being forced up by the pressure of the water against the deck, a two-inch deal or cross-piece was laid over every beam from the ship's side to the uprights at the middle line ; then, at equal distance from the side and middle line, pieces of six inches square, as long as could be gotten down, were put all fore and aft on both sides, scored two inches over every cross piece, and well bolted through the cross piece and deck, and into the fir beams. From this fore-and-aft piece or ribband to the ship's side, and from it to the uprights in the middle, were placed two rows of diagonal shores, six inches square, the heels of which were securely wedged against the fore-and-aft piece or ribband, which afforded sufficient support to the temporary deck without any other shores. Two bulkheads or partitions were built, as far as the foremast forward, and mizen-mast aft, well planked, shored, and caulked, to resist the water. As decks laid in this manner, and in so much hurry as the time of low water requires, will of consequence leak in some degree, and as that leakage, washing from side to side, will cause the ship to lay along, I fixed a two-inch deal, twelve inches broad, edgeways, all fore and aft at the middle line, and well caulked it, to stop half the water on the weather or upper side, when the ship should incline either way, which not only made her stiffer under sail, but facilitated the pumping out the water made by leaks in the deck.

This deck was sixty-three feet long and twenty-three feet broad, and was laid at five feet five inches above the bottom of the keel, or four feet above the top of the floor timbers, and swam the ship at twelve feet five inches water, resisting two hundred and sixteen tons, and containing under it one hundred and twenty-four tons of water, which, pressing against the under side of the temporary deck, acted as ballast, and brought her safely into the dry dock at Deptford, from the most dangerous situation possible, being partly within and partly without Margate Pier, where she had been left by some Ramsgate men, who had undertaken to remove her from the place where she was stranded to a safer one within Margate Harbour.

2. ACCOUNT OF THE METHOD USED IN RECOVERING THE DUTCH FRIGATE AMBUSCADE, OF 32 GUNS, SUNK NEAR THE GREAT NORE. BY MR. JOS. WHIDBY, *Master Attendant of his Majesty's Yard at Sheerness.*

(From the Philosophical Transactions.)

At eight o'clock in the morning of the 9th day of July, 1801, the Dutch frigate Ambuscade left her moorings in Sheerness Harbour, her foresails, topsails, and topgallant sails being set, with the wind aft, blowingstrong. In about thirty minutes she went down by the head near the Great Nore; not giving the crew time to take in the sails, nor the pilot or officers more than four minutes notice before she sunk; by which unfortunate event twenty-two of the crew were drowned.

This extraordinary accident was owing to the hawse-holes being extremely large and low, the hawse plugs not being in, and the holes being pressed under water by a crowd of sail on the ship, through which a sufficient body of water got in, unperceived, to carry her to the bottom.

The instant she sunk, she rolled over to windward across the tide, and lay on her beam ends; so that, at low water, the muzzles of the main-deck guns were a little out of the water, and pointed to the zenith, with 32 feet of water round her.

The first point I had to gain was, to get her upright. Before I could accomplish it, I was obliged to cut away her foremast and main topmast; which had no effect, until the mizen mást was also cut away; she then instantly lifted her side, so that at low water the lee railing on the quarter-deck was visible.

By proceeding in this manner, the first part of my object was obtained, with a secured main-mast and all its rigging, to enable me, should I be fortunate enough to weigh the ship, to lighten her with the greatest possible expedition.

The ship being in the forementioned state, gave me an opportunity, the next low water, to get out her quarter, forecastle, and some of her main-deck, guns, with a variety of other articles.

I next proceeded to sling her; which was done with two nineteen-inch cables, divided into eight equal parts. The larboard side of the ship being so much higher than the starboard, enabled me to clench each of the ends round two of the ports, excepting one that was clenched round the main-mast; and, with great difficulty, by long rods and diving, I got small lines rove through four of the ports on the starboard side, by which means I got four of the cables through those ports across her deck, which were clenched to the main-mast and larboard side, having four ends on each side completely fast, at equal distances from each other. I brought the Broederscarp, of 1063 tons burthen, out of the harbour, which received the four ends on the starboard side; also four lighters, of 100 tons each, which took in the other four ends on the larboard side, over their bows. All the eight ends were, at low water, hove down with great power, by a purchase lashed distinctly on each of them. I then laid down two 13-inch cables, spliced together, with an anchor of 24 cwt. in a direction with the ship's keel. On the end of the cable next the frigate a block was lashed, through which was rove a 9-inch hawser, one end of which was made fast to the ship; the other end was brought to a capstan on board the Broederscarp, and hove on it as much as it would bear, with an intention to relieve the frigate from the powerful effect of cohesion. This had so far the desired effect that, at about half flood, I perceived the ship to draw an end and swing to the tide; and all the slings were considerably relieved. At high water she was completely out of her bed. At the next low water I hove all the purchases down again. At half flood she floated; and the whole group drove together into the harbour, a distance of three miles, and grounded the frigate on the west side of it. It took me two tides more to lift her on the shore, sufficiently high to pump her out; which was then done with ease, and the ship completely recovered, without the smallest damage whatever either to her bottom or her sides.

I do not apprehend that there is any thing new in the mode which I adopted in weighing the Ambuscade, excepting the idea of removing the effect of cohesion, by the process before described; and I have every reason to think that, if the same principle had been acted on in the attempt made to weigh the Royal George, it would have succeeded.

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§ 6. DESCRIPTION OF MACHINES FOR DRIVING AND DRAWING SHIPS' BOLTS, &c.

(From the Transactions of the Society for the Encouragement of Arts, &c.)

1. DESCRIPTION OF AN IMPROVED METHOD OF DRIVING BOLTS INTO SHIPS. BY MR. RICHARD PHILLIPS, OF BRISTOL. *(See Plate I, Figures 1 to 4.)*

MR. RICHARD PHILLIPS, of Bristol, in several letters sent to the Society, states, that he had invented a method of driving copper bolts into ships without splitting the heads or bending them; and that, by means of tubes, contrived by him for the purpose, this could be effected without difficulty, and had been satisfactorily executed in the presence of several of the principal ship-builders of Bristol.

A certificate accompanied these letters, from Mr. William James and Mr. Samuel Hast, ship-builders, and also from Mr. George Winter, of Bristol, testifying that they had tried the experiment of driving copper bolts through the jointed cylinder invented by Mr. Phillips; and that they so far approve of it, that they mean to adopt the general use of them, for driving bolts in all directions, particularly on the outside of ships, whether iron or copper; as this method not only prevents the bolts from bending, but keeps the heads from splitting, and enables the bolts to be driven much tighter than by any other means with which they are acquainted. They further add, that, by the application of Mr. Phillips's cylinder and punch, a copper bolt which had been crippled at the edge of the hole, and which could not be started by a mall, went up with ease in a perpendicular direction in the flat of a ship's bottom, not four feet from the ground.

The same facts were also certified by Mr. Thos. Walker, and Mr. J. M. Hillhouse, of Bristol, who add their opinion, that the adoption of this invention, in the different dock-yards of the kingdom, will prove very advantageous.

The instrument employed for driving the bolts consists of a hollow tube, formed from separate pieces of cast iron, which are placed upon the heads of each other, and firmly held thereto by iron circles of rings over the joints of the tube. The lowest ring is pointed, to keep the tube steady upon the wood. The bolt having entered into the end of the hole bored in the wood of the ship, and completely covered by the iron tube, is driven forward within the cylinder by an iron or steel punch, placed against the head of the bolt, which punch is struck by a mall: and, as the bolt goes farther into the wood, parts of the tubes are unscrewed and taken off, till the bolt is driven home into its place up to the head.

The tubes are about five inches in circumference, and will admit a bolt of seven-eighths of an inch in diameter.

REFERENCES TO THE PLATE.

Fig. 1. A, the copper bolt, with one end entered into the wood, previous to fixing the tube.
B, a piece of timber, or ship's side, into which the bolt is intended to be driven.

Fig. 2. C, C, C, C, the parts of the iron tube, fastened together, ready to be put on the bolt A.
D, D, D, D, D, iron or brass rings, with thumb-screws, placed over the joints of the tube, to hold them firmly together.
E, E, E, E, E, the thumb-screws, which keep the rings and tubes firmly in their proper places.
F, two points formed on the lower ring: they are to strike into the timber, and to enable the tube to be held firmly in its place.

Fig. 3. shews the separation of the parts of the tube, which is effected by slackening the thumb-screws and rings.

To put them together, you slide the rings over the joints, placed as closely as possible; then, by tightening the thumb-screws, you will have them firmly together, and may continue the tubes to any length, from one foot to whatever number may be required.

Fig. 4. G, H, two steel punches or drifts, to be placed on the head of the copper bolt within the tube whilst driving. The blow given upon the punch drives forward the bolt. The shortest of them should be used first, and, when driven to its head, should be taken out of the tube, and the longer punch applied in its place.

The Instrument represented by Fig. 5. on Plate 1. is a socket punch, the hollow part of which, being firmly held over the head of a bolt, whilst driving, will, generally, in skilful hands, be found to answer the purpose of Mr. Phillips's machine.

2. DESCRIPTION OF A MACHINE, INVENTED BY MR. WM. HILL, FOR DRAWING BOLTS OUT OF SHIPS.
(See Plate I, *Figures* 6 *and* 7.)

First, the use of this machine is to draw the keelson and dead-wood bolts out, and to draw the knee of the head bolts.—Secondly, the heads of the keelson bolts heretofore were all obliged to be driven through the keelson, floor timbers, and keel, to get them out: by these means the keelson is often entirely destroyed, and the large hole that the head makes materially wounds the floors; and, frequently, when the bolt is much corroded, it scarphs, and the bolt comes out of the side of the keel.—Thirdly, the dead-wood bolts, that are driven with two or three drifts, are seldom or never gotten out; by which means the dead-wood is condemned, when some of it is really serviceable.—Fourthly, in drawing the knee of the head-bolts, sometimes the knee starts off, and cannot be gotten to again, but furs up, and with this machine may be drawn in; for it has been proved to have more power in starting a bolt than the mall.

In Fig. 6. AA represent two strong male screws, working in female screws near the extremities of the cheeks, against plates of iron EE.—CC is the bolt to be drawn; which, being held between the chaps of the machine at DD, is, by turning the screws by the lever B, forced upwards out of the wood or plank of the ship. FF are two dogs, with hooks at their lower extremities; which, being driven into the plank, serve to support the machine till the chaps have got fast hold of the bolt. At the upper part of these dogs are rings passing through holes in a collar, moveable near the heads of the screws.

Fig. 7. is a representation of one of the cheeks as separated from the other.

This machine was first tried in his Majesty's yard at Deptford, and was found of the greatest utility.—First, it drew a bolt that was driven down so tightly as only to go one inch in sixteen blows with a double-headed mall, and was well clenched below: the bolt drew the ring a considerable way into the wood, and wiredrew itself through, and left the ring behind.—Secondly, it drew a bolt out of a frigate's dead-wood that could not be gotten out by the mall. That part of it which went through the keel was bent close up to the lower part of the dead-wood, and the machine drew the bolt straight, and drew it out with ease. It also drew a keelson-bolt out of the Stanley West-Indiaman, in Messrs. Wells's yard, at Deptford; which, being a bolt of two drifts, could not be driven out.—These instances are sufficient to shew the great powers and utility of the machine.

The machines are formed of two sizes; the length of the arms or cheeks of the larger is about two feet nine inches, and of the smaller about eighteen inches. The jaws or stouter parts are about seven inches deep, and about three inches substance in the thickest part.

The small ends, in which the screws work, are about three inches and a half broad, and two inches thick.

The screws are about one and three quarters or two inches in diameter, and about two feet in length. The heads are globular, and sufficiently large to admit of a hole for a lever about one inch in diameter.

The dimensions of the smaller machine, or that of eighteen inches long, are, of course, in the same proportions.

3. DESCRIPTION OF A MACHINE FOR DRAWING BOLTS IN AND OUT OF SHIPS. BY CAPT. WM. BOLTON, R. N.

In an introductory letter, Capt. Bolton observes, that one of the premiums of the Society is for *driving* bolts, but he hopes that *drawing* them in will be successful. And, that he flatters himself his method of drawing them out will be found an improvement upon any plan hitherto offered for that purpose, as the machine can be easily worked, in very little room, and will generally bring the bolt out uninjured.

The machine consists of a frame (Plate 1. Fig. 8.), supporting a cylindrical female screw tube. On this tube is mounted a wheel, with teeth adapted to an endless screw, fitted to the frame, and worked by a handle.

A A A A A A (see the plate) represent the frame of the machine. B, a cylindrical tube, having a female screw in the inside. C, a wheel with teeth, attached to the cylinder B. D, an endless screw, adapted to the wheel C. E, handle of the winch. F, the bolt drawing out. G, G, blocks to support the frame. H, a hollow piece of steel, having on its outside a male screw, whose threads work within the female screw in the cylinder B: to this piece of steel the bolt is to be rivetted. I, a semicircular piece of steel, which is to be introduced into the notches on H, when a similar notch has been cut in the head of the copper bolt, which, by this means, is prevented from turning in H, while drawing K, the bolt, as prepared to receive the machine. L, a steel bar, somewhat smaller than the bolt to be drawn, having at one end a male screw *a*, and at the other end another male screw, that fits into the female screw in B. M, a section of a male screw, having a square hole, larger than the bolt. N, a bolt, with a male screw at one end, ready to be drawn in.

To draw the Bolt out.—The head of the bolt must be cut off, and a hole made in the timber, big enough to receive the male screw H, which is put over the bolt; a slit is then to be made, either by a saw or cold chisel, in the head of the bolt, to receive the key I, which corresponds to the slit in H; and the head of the bolt is then to be rivetted, as firmly as possible, upon H. The cylindrical tube B is then to be screwed on, turning the whole machine round, till it can be done no longer, when the endless screw is to be used. If the machine is of a proper strength, and the rivetting well done, the power is such as to extract the bolt or break it; but, generally, it will be drawn out uninjured.

To draw Bolts into Ships.—It will be necessary to have a bar L, which I recommend to be made of steel, long enough to pass from the inside to the outside of the ship, and somewhat smaller than the copper bolt intended to be drawn in: this may be called a *Conductor*. On one end should be a male screw *a*. The bolt to be drawn in should be tapped at one end, to receive the male screw *a* on the conductor: at the other end should be another male screw, that fits into the female screw in B; after which, the operation is the same as drawing a bolt out, and the machine should be applied accordingly. When the bolt arrives at its destined place, it may be secured on the inside, by a nut, which is as good a way of fastening as clenching, and much more expeditious.

This machine, though only of the height of eighteen inches, will draw bolts in or out, of any length; for, after the bolt has risen to the top of the tube, it will only be necessary to screw the machine back, and follow up the work with blocks of timber, as represented in the figure.

If the upper part of the hole in H be made square, larger than the round hole, as shewn at M, and the head of the bolt rivetted into it, it will do away the necessity of the key I, render the machine less complicated, and save much time and trouble.

4. DESCRIPTION OF A NAIL AND BOLT DRAWER. BY MR. WM. RICH, OF YALDING.

(See Plate 1. Fig. 9.)

THE annexed plate and description will shew the form of this tool, which has been found of considerable use to workmen concerned in breaking up ships, and in other employments where large nails or spikes have been strongly driven into wood, and it has become necessary to extract them.

The figure on the plate represents the nail-drawer in the action of extracting a spike; where A B shews the piece of timber, C the nail or spike to be drawn, D E the shape of the tool, consisting of a lever D, moving on a solid part, in form of the segment of a circle, at E; a square staple F turns on a centre at G, and the spike to be drawn being held between the end of the lever and the staple, any pressure at D acts with an effect proportional to the distance *a* F and D *a*, and consequently enables the workman to exert a very great force against the spike C.

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§ 7. OBSERVATIONS UPON TIMBER, WITH RULES FOR ITS ADMEASUREMENT AND CONVERSION.

HAVING, in the foregoing Chapters of this Book, laid down and explained whatever is necessary to be understood in the laying-off of a ship on the mould-loft floor, and shewn the methods by which all the moulds may be made, in order to convert the timber into its proper shape; we shall now proceed to lay down a few observations and rules for the admeasurement of timber, so that the student may become acquainted with that part of his business: for we suppose him now to be qualified, from what has been said in this treatise, to build and complete a ship of any dimensions.

In ship-building this branch is as absolutely necessary to be known, as any other throughout the whole art; for, without the knowledge of it, however the artist may be skilled in every other point, he would appear in a very disadvantageous light, if, when he has the materials to procure, for the purpose of building, he should be found incapable, and he could not then display those good abilities which he may possess.

Timber is generally divided into the following classes; viz. Rough timber, square or hewn timber, sided timber, thickstuff, and plank. By rough timber is understood timber of the full size of the tree, as it grows, without the lop, top, and bark (unless the timber is bought standing); if so, it is generally sold by the lot, and then the buyer can only be guided by his judgment, both in regard to the quality and quantity.

Rough timber may be kept in piles, shedded over, without injury, for six years or more; it is nevertheless certain, that timber, in all situations, may be kept in a state of seasoning too long.

When timber is converting, it should be spread about as much as possible, that the moulds may be the more readily applied on the most suitable pieces. By which great saving of timber will be made in the conversion. This practice might also be of great advantage in point of strength to the ship; as there would be no occasion to use any timber but such as is of proper size and growth. The French have long made it a practice to convert the timber in the place where it grows; a practice much to be recommended here, particularly in some inland counties, where there are many fine oaks, not purchased for ship-building, owing to the great expence of carriage.

N.B. Winter felled timber is always to be preferred to that felled in other seasons; but to this may be attached the extra expence of barking the tree standing.

All timber is bought and sold by the load, and a load is fifty feet, which is supposed to weigh a ton, or twenty hundred weight; but some reckon forty feet of rough or unhewn timber to the load; for they say, that, as hewn timber is measured by the square, it is very nearly exact; but rough timber, being measured by the girt (or quarter compass), which is more than one-fifth less than exact, therefore, in the buying and selling of timber, it amounts to much the same, whether it is measured to the girt, at forty feet solid to the load, or measured exactly at fifty feet to a load, the price being in proportion. In the King's yards forty feet of hewn timber is reckoned a ton, and fifty feet of such timber goes to a load.

There are several other particulars which occur in the measuring of timber, &c. for sale, all of which we shall sufficiently explain under their different heads.

1. TO MEASURE AND COMPUTE THE SOLIDITY OF ROUND OR ROUGH TIMBER, WHEN THE TREE IS STRAIGHT, AND THE ENDS EQUAL OR NEARLY SO.

RULE I. OR COMMON RULE.

Multiply the square of one-fourth of the circumference by the length, and the product will be the solidity, or the contents.

The circumference is taken by a leather strap, or a tape, a small cord, or line; and that circumference, divided into four, is termed the girt: this is considered as though it was the side of a square, whose area is agreeable to the section of the tree at that place where it was girted.

EXAMPLE.

What is the solid contents of a tree, whose circumference is 64 inches, and the length 24 feet?

One-fourth of 64 is 1 foot 4 inches, which, multiplied by 1 foot 4 inches, is equal to 1 foot 9 inches, and 4 twelfths or seconds.

Then 1 foot 9 inches 4 seconds, multiplied by 24 feet, is equal to 42 feet 8 inches, the solidity.

BY THE SLIDING RULE.

As the length upon C : 12 or 10 upon D :: quarter girt, in 12ths or 10ths, on D : the content on C.

Note 1. But, if the tree should not be straight, then the length must neither be taken on the concave or convex side, but in the middle.

2. TO MEASURE AND COMPUTE THE SOLIDITY OF ROUND OR ROUGH TIMBER WHEN THE TREE TAPERS, OR IS UNEQUALLY THICK.

Rule 2. When the tree is tapering, girt in the middle, for the mean girt, or at the two ends, and take half the sum of the two. But, when the tree is very irregular, girt it in as many places as are thought necessary, and find the contents of each part separately: or else, add all the girts together, and divide the sum by their number, gives (as supposed) the mean circumference: the fourth of that square, multiplied by the length, gives the solid contents.

EXAMPLE.

A tapering tree is girted in four places, the girts being as follow: first, 3 feet 9 inches; second, 4 feet 5 inches; third, 4 feet 9 inches; and fourth, 5 feet 9 inches: the length being 20 feet, what is the solidity?

To 3 feet 9 inches add 4 feet 5 inches, add 4 feet 9 inches, add 5 feet 9 inches, is equal to 18 feet 8 inches; thus, divide by 4, is equal to 4 feet 8 inches, the mean compass.

Then 4 feet 8 inches, divided by 4, is equal to 1 foot 2 inches; multiplied by 1 foot 2 inches, is equal to 1 foot 4 inches 4-twelfths; 1 foot 4 inches 4-twelfths, multiplied by 20, is equal to 27 feet 2 inches and 8-twelfths, the solidity.

Note 2. This rule, which is commonly used, gives the answer about one-fourth less than the true quantity would be after the tree is hewed square in the usual way; so that it seems intended to make an allowance for the squaring of the tree. When the true quantity is desired, use the following rule.

3. TO MEASURE AND COMPUTE THE TRUE SOLIDITY OF ROUND OR ROUGH TIMBER.

Rule 3. Multiply one-fifth of the mean girt by double the length, and the product will be the content very nearly.

EXAMPLE.

What are the true solid contents of a tree, whose circumference is 64 inches, and the length 24 feet?

One-fifth of 64 is 12 . 9 . 7, which, multiplied by 48 feet, is equal to 50 feet 7 inches 8 parts, the true solidity.

BY THE SLIDING RULE.

As the double length on C : 12 or 10 on D : : 1-fifth of the girt, in 12ths or 10ths, on D : the content on C.

4. TO MEASURE AND COMPUTE THE SOLIDITY OF SUCH TREES AS HAVE THEIR BARK ON.

In measuring such timber for sale, it is common to make an allowance or deduction to the buyer on account of the bark, which is generally one-twelfth part of the circumference. This deduction being made, is supposed to reduce the compass to that which the tree will have when the bark is stripped off.

Rule 4. From the given circumference, deduct the allowance for bark; and, with the remaining compass, find the solidity by one of the foregoing rules.

EXAMPLE.

A tree is 40 feet long and 2 feet 8 inches quarter compass: required the solid contents, allowing 1-12th for bark.

1-12th of 2 feet 8 inches is 2 in. 8 pts.; then from 2 ft. 8 in. deducting 2 in. 8 pts. leaves 2 ft. 5 in. 4 pts. reduced quarter. Then 2 ft. 5 in. 4 pts. multiplied by 40 feet, is equal to 97 ft. 9 in. 4 pts. the solid content.

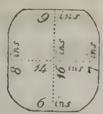
This is the class of timber usually bought by merchant-builders; and, to give some idea of the price, we annex the prices per foot given for the undermentioned trees, bought in the year 1803, and measured after each tree was felled and stript. The buyer had the lop, top, and bark, to defray the expences of felling and clearing; and the trees were measured as far as each would hold seven inches girt or twenty-eight inches circumference.

The following were the prices per foot, according to the respective meetings: 100 feet, 4*s.* 6*d.* per foot; 90 feet, 4*s.* 3*d.*; 80 feet, 4*s.*; 70 feet, 3*s.* 9*d.*; 60 feet, 3*s.* 6*d.*; 50 feet, 3*s.* 3*d.*; 40 feet, 3*s.*; 30 feet, 2*s.* 9*d.*; and 20 feet, 2*s.* 6*d.*

The next class is the SQUARE OR HEWN TIMBER, which is always squared by the merchants before it is served into the King's or other yards for the purpose of ship building. Hence the defects are more easily discovered, and proper abatements made in the price accordingly.

The Contracts for the Navy say, that all timber must be squared in such a manner, that the sum of the breadth of the slabs taken off shall not be less than twice the sum of the wanes; if they are less, then the King's measurers cause the uppersides to be hewed until the dimensions are reduced to the terms above-mentioned; and, when the timber is measured, the sides of it, thus squared, are taken by a pair of callipers each way, and the two squares so taken are added together, the half of their sum gives a mean which, being multiplied by itself, and then into the length, produces the contents.

The last method of squaring rough timber, in order for measuring, is, that the four squares shall be equal to the two diameters, or more if possible, viz.



Four squares { In. 9, 6, 7, 8 } = 30

Both diameters { In. 16, 14 } = 30

5. TO MEASURE AND COMPUTE THE SOLIDITY OF SQUARE TIMBER, AS RECEIVED INTO THE KING'S AND OTHER YARDS.

As, in consequence of the great irregularity in the growth of that timber which is most useful in ship-building, the taking a mean out of several girts or dimensions is not sufficiently accurate, the method that is used in the King's and other yards is, to measure the tree into as many lengths as the measurers shall judge proper; (that is, they mark off the different lengths as far as the tree regularly tapers;) and then find the contents of each length separately, and adding the whole together; thus are the contents of the whole tree obtained, with branches or boughs measuring two feet compass, or six inches girt, which are reckoned as timber; their solidity being computed and added to that of the tree: but, so much of the trunk, boughs, or branches, as measure less than six inches, are not esteemed timber, and therefore not added to the other contents.

Rule 5. Measure the tree into as many lengths as may be judged necessary, then find the contents of each length as follows: when the lengths are set off, take the size of the tree upon the parts that are squared both ways, and exactly in the middle of each length; then add the two squares together; next take one half, which will give a mean square; multiply the mean square by itself, and the product by the respective length, the last product will be the contents: next add the contents of every length so found, and the total will be the solidity of the whole tree in feet; which, being divided by 50, the quotient will be the number of loads contained in the whole tree or number of trees.

Note 1. The mean square is a geometrical mean proportional between the mean breadth and thickness; that is, the square root of their product. Sometimes unskilful measurers use the arithmetical mean instead of it, that is half their sum; but this is always erroneous; and, the more so, as the breadth and depth differ the more from each other.

EXAMPLE.

Required the solidity of a tree, whose dimensions are as follow: first length 18 feet; the square 16 inches by 18 inches; second length 12 feet; square 14 inches by 12 inches; third length 10 feet; square 10 inches by 8 inches; one branch, length 9 feet; square 8 inches by 6 inches; and another branch, length 8 feet; square 9 inches by 7 inches.

	Ft. In.		Ft. In.		Ft. In.		Ft. In.		In. In.	
Mean Square	1 5	×	1 5	=	2 0 1	×	18 0	=	36 1 6	Contents of the first length.
	1 9	×	1 1	=	1 2 1	×	12 0	=	14 1 0	Second length.
	9	×	9	=	0 6 9	×	10 0	=	5 7 6	Third length.
	7	×	7	=	0 4 1	×	9 0	=	3 0 9	Of one branch.
	8	×	8	=	0 5 4	×	8 0	=	3 6 8	Of the other branch.
							Solidity of the tree......		62 5 5	

The calculating of the dimensions by figures as above, shews the exact contents of the tree (according to the rule observed) to the twelfth part of an inch; but, as that would be so very tedious in measuring timber for sale, or in receiving it into store, the measurers, for quick dispatch, make use of the sliding rule; by which they calculate no nearer than to the half of a foot in the contents of each length; but that will be of little or no consequence; because the loss thereby will not be more than the odd inches in the above tree. After finding the contents of each length, by the sliding rule, they proceed as before, by adding them all into one sum for the contents of the whole.

TO FIND THE CONTENTS OF EACH LENGTH BY THE SLIDING-RULE.

As 12 on the girt line, is to the *length* on the slider; so is the *mean square* on the girt line, to the *contents* on the slider.

TO FIND A MEAN PROPORTIONAL BETWEEN TWO NUMBERS BY THE RULE;

As suppose between 29 and 430. Set the one number 29 on C to the same on D; then against the number 430 on C stands their mean proportional 111 on D.

TO SQUARE ANY NUMBER BY THE RULE.

Suppose to square 23. Set 1 on B to 23 on A; then against 23 on B stands 529 on A, which is the square of 23.

TO EXTRACT THE SQUARE ROOT BY THE RULE.

Set 1 or 100, &c. on C to 1 or 10, &c. on D; then against every number found on C stands its square root on D.

So against 529 stands its root 23, and
against 400 stands its root 20, &c.

THE PRICE GIVEN FOR THE SEVERAL METINGS OF OAK AND ELM TIMBER BY GOVERNMENT, AND DELIVERED AT THE YARD, IN THE YEAR 1804.

CONTENTS.		LENGTH.		PRICE PER LOAD.					
Metings.	Lowest.	Metings.	Lowest.	Oak.			Elm.		
				£.	s.	d.	£.	s.	d.
270	230	38	26	7	16	0	5	6	0
260	221	37	26	7	15	0	5	5	0
250	213	...	...	7	14	0	5	4	0
240	204	...	...	7	13	0	5	3	0
230	196	36	26	7	12	0	5	2	0
220	187	...	...	7	11	0	5	1	6
210	197	35	26	7	10	0	5	0	0
200	170	...	...	7	9	0	4	18	0
190	162	...	...	7	8	0	4	17	6
180	153	34	26	7	7	0	4	15	6
170	145	33	26	7	6	0	4	13	6
160	136	32	26	7	5	0	4	11	6
150	128	...	...	7	3	0	4	9	0
140	119	...	...	7	1	0	4	7	0
130	111	...	...	6	19	0	4	5	0
120	102	...	...	6	17	0	4	3	0
110	94	31	25	6	15	0	4	0	0
100	85	30	25	6	13	0	3	18	6
90	77	28	24	6	8	6	3	16	6
80	68	...	...	6	3	6	3	12	0
70	60	...	...	5	18	6	3	7	0
60	51	27	23	5	13	6	2	18	6
50	43	26	22 } Elm.	5	6	0	2	11	0
40	34	25	20 }	4	13	6	2	4	6
30	26	..	...	4	3	6			

N. B. There is an addition of 6 per cent. to these prices for the oak timber.

N. B. Ten shillings per load allowed, in addition to these prices, in consideration that no other tops are to be received, except such as are mentioned in the 15th article of the contract.

N. B. The elm to square at the given lengths, not less than 12 inches; and to square at the top end 9 inches; with an addition of ten shillings per load for such elm timber as shall, on conversion, prove fit for keel pieces for 64 gun ships and upwards, meeting in length at 28 feet, the lowest 24 feet. The spire and one limb to be measured into the contents of elm timber (if cut for convenience of carriage) but, by no means to be received unless it is brought with the piece, so that it may be compared, and known to be cut therefrom.

The price of timber, of any metings not in the table, may be easily found by a sliding rule that is graduated with the cube line and root line. Or, by the single line of numbers, by dividing the difference of the metings or sizes of the timber into three parts, one of these parts extended from the piece of timber whose metings are given either forwards or backwards, as the question is stated, shews the price sought. Or, by figures, thus: as the cube root of the metings given is to its price, so is the cube root of the metings required to its price, by the direct rule of proportion.

The price of beech timber was, at the same time, four shillings per load less than that of elm, of the same metings; and the price for ash timber, three pounds per load.

The next class of timber is the SIDED, which is only bought so by Government; the various sidings, &c. are regulated by a contract, the particulars of which are as follow.

The lengths to be measured in the middle of the timber sideways, the springings, roundings, or risings of the timbers, to be measured by a square from a level line across the piece, at the proper place for the cutting-down to the outside of the timber head; and, that care be taken that the intermediate springings are proportional to the respective intermediate lengths. The shortest of these timbers may be reduced to the lesser sidings for each class, respectively, if the wood will not hold for the larger; and, for all such as spring within the angle of knee timber, to be allowed £11. 7*s*. per load.

FLOOR TIMBERS. To be sided only to the following dimensions, with a proper depth in the middle, the moulding way, for the cutting-down, and with a sufficient round or springing at the heads. The length to be measured on the middle of the timber sideways.

Guns.		Ft.	In.		Ft.	In.		Price per Load.		
Ship of 100	Length from	29	6	to	27	0	Sided 16 inches	£10	10	6
74	....	26	6	to	25	0	... 15½	9	12	0
50	....	22	6	to	21	6	... 14½	9	0	0

RISING TIMBERS. To be sided only to the following dimensions, and out of such timber as is grown to proper shapes; springing at the heads, and large enough at the arms for moulding and bevelling for the fore and after parts of the ship.

Gun-sh.		Ft.	In.		Ft.	In.		In.		In.			Per Load.		
100	Length from	26	6	to	19	0	Rounding from	10	to	33	Sided	14½	£10	13	0
74	....	22	6	to	17	0	....	16	to	36	...	14 ..	9	12	0
50	....	18	6	to	14	6	....	20	to	36	...	13½ ..	9	4	0

LOWER FUTTOCKS. To be sided only to the following dimensions, and the longest timbers to have the greatest roundings.

Gun-sh.		Ft.	In.		Ft.	In.		In.		In.		Per Load.		
100	Length from	21	0	to	19	6	Rounding from	36	to	24	Sided 15¾	£12	1	6
		19	6	to	18	0	....	24	to	16	....	11	4	6
		18	0	to	16	6	....	16	to	10	....	10	10	6
74	....	19	0	to	18	0	....	31	to	24	Sided 15 ..	11	6	0
		18	0	to	17	0	....	24	to	17		10	11	6
		17	0	to	16	0	....	17	to	10		9	18	6
50	....	17	6	to	16	6	....	26	to	22	Sided 14½ .	10	13	0
		16	6	to	15	0	....	22	to	16		10	0	6
		15	0	to	14	0	....	16	to	13		9	7	0

SECOND FUTTOCKS. To be sided only to the following dimensions and the longest timbers to have the greatest roundings.

Gun-sh.		Ft.	In.		Ft.	In.		In.		In.		In.	Per Load.		
100	Length from	16	6	to	15	0	Rounding from	22	to	12	Sided	15 .	£10	1	6
74	....	14	6	to	13	6	....	17	to	11	...	14¼ ..	9	10	0
50	....	13	6	to	12	0	....	15	to	10	...	13½ ..	8	9	6

DOUBLE FUTTOCKS in the FORE BODY (comprising the half floor and second futtocks).

Gun-sh.		Ft.	In.		Ft.	In.		In.		In.		In.	Per Load.		
100	Length from	24	9	to	21	4	Rounding from	9	to	4	Sided	14 ..	£11	1	6
74	....	22	3	to	19	2	....	5	to	6	.....	13½ ..	10	6	0
50	....	20	4	to	17	0	....	8	to	5	.....	13 ...	9	13	0

DOUBLE FUTTOCKS in the AFTER BODY (comprising the half floor and second futtocks).

Gun-sh.		Ft.	In.		Ft.	In.		In.		In.		In.	Per Load.		
100	Length from	26	10	to	25	0	Rounding from	12	to	27	Sided	14	£11	7	0
74	....	24	0	to	22	6	....	18	to	24	...	13½	10	18	6
50	....	21	0	to	19	0	....	22	to	28	....		10	9	6

FOREMOST FASHION PIECES.

Gun-sh.		Ft.	In.		In.		In.	Per Load.		
100	Length	27	0	..... Rounding ..	39	Sided	14 ...	£11	7	0
74	....	23	6	....	48	..	13½ ...	10	18	6
50	....	19	6	....	36	..	13	10	9	6

THIRD FUTTOCKS. To be sided only to the following dimensions, and as many of them as can be gotten to be 4 feet 6 inches longer than the length specified: The shortest timbers to have the greatest roundings:

Gun-sh.		Ft.	In.		Ft.	In.		In.		In.		In.	Per Load.		
100	Length from	16	6	to	15	0	Rounding from	16	to	22	Sided	14½	£10	7	6
74	....	14	6	to	13	6	....	14	to	21	...	13¾	10	2	6
50	....	13	6	to	12	0	....	14	to	21	...	13¼	9	8	6

UPPER FUTTOCKS. To be sided only to the following dimensions. The shortest timbers to have the greatest roundings; and, if the piece will hold, 7 feet longer upwards, and sufficient substance. The moulding way to convert for an upper futtock and toptimber in one; the increase thereby to be taken into the contents of the piece in a converted state.

Gun-sh.		Ft.	In.		Ft.	In.		In.		In.		In.	Per Load.		
100	Length from	20	6	to	19	6	Rounding from	25	to	30	Sided	14	£12	7	0
		19	6	to	18	6		30	to	36					
		18	6	to	17	0		36	to	42					
74	.....	19	0	to	18	0	Rounding from	27	to	35	Sided	13½	11	18	6
		18	0	to	17	0		35	to	41					
		17	0	to	15	6		41	to	47					
50	.....	17	0	to	16	0	Rounding from	27	to	40	Sided	13¼	11	9	6
		16	0	to	15	0									
		15	0	to	14	0									

TOPTIMBERS. To be sided only to the following dimensions. Those for the fore and after parts of the ship to be left longer than the piece will admit, and the additional length to be taken into the contents of the piece in a converted state.

Gun-sh.		Ft.	In.		Ft.	In.		In.	Per Load.		
100	Length from	24	6	to	32	6	Sided	13½ ..	£10	1	6
74	......	18	0	to	24	0	...	13½ ..	9	13	0
50	......	16	0	to	22	0	...	13 ..	8	10	0

UPPER STEM PIECES. To be sided only to the following dimensions; and of a parallel thickness, at least one-third of the length of the piece, and the piece to be left as much longer as it will hold.

Gun-sh.		Ft.	In.		In.	Per Load.		
100	Length	24	6	Sided	30	£13	4	6
74	....	18	6	...	27	12	6	0
50	....	17	6	...	22	10	9	0

MIDDLE AND LOWER STEM-PIECES. To to be sided only to the following dimensions. N. B. Not to be more than six lower and middle stem-pieces to every 1,000 loads of timber.

Gun-sh.		Ft.	In.		In.	Per Load.		
100	Length	20	6	Siding	20	£13	4	6
74	....	17	6	....	18	11	19	6
50	....	15	6	....	16	10	14	0

BOLLARD TIMBERS. To be sided only to the following dimensions of young timber, and the soundest possible.

Gun-sh.		Ft.	In.		In.	Per Load.		
100	Length	28	6	Sided	17	£10	11	6
74	....	22	6	...	16	10	0	6
50	....	21	0	...	14	9	6	6

HAWSE-PIECES. To be sided only to the following dimensions: To be of young and the soundest timber, of such breadth, the moulding way, as to allow of sufficient bevelling wood; and to be left as much longer than the lengths specified as the piece will hold.

Gun-sh.		Ft.	In.		Ft.	In.		In.	Per Load.		
100	Length from	24	0	to	20	0	Sided	20 / 21	£10	14	0
74	....	20	0	to	17	0	Sided	17 / 18	10	7	0
50	....	19	0	to	15	6	Sided	15 / 16	9	12	6

DECK BREASTHOOKS. To be sided only to the following dimensions, with a proper round up or sufficient wood to obtain it left; which wood, however, is not to be taken into the contents of the piece. To be left as broad as may be the moulding way.

Gun-sh.		Ft.	In.		In.	Per Load.		
100	Length	22	0	Sided	15	£11	17	6
74	.....	20	6	....	14	10	18	6
50	.....	18	6	....	12½	10	5	0

BREASTHOOKS are generally to be sided only to the following dimensions and straight, and to mould so full in the breech or throat as to require as little chock as possible.

Gun-sh.		Ft.	In.		Ft.	In.		In.	Per Load.
100	Length	19	6	to	16	0	Sided	15	£11 17 6
74	......	19	0	to	16	0	....	14	10 18 6
50	......	17	0	to	14	6	....	12½	10 5 0

KEELSON PIECES. To be sided only to the following dimensions; but of such breadths, the moulding way, as to produce square edges when the piece is converted for use.

Gun-sh.		Ft.	In.		Ft.	In.		Ft.	In.		In.	Per Load.
100	Length from	37	0	to	30	0	Metings in Length	34	6	Square	20	£11 1 6
74	....	36	0	to	28	0	....	32	6	....	18	11 8 0
50	....	34	0	to	27	0	....	31	0	....	16	10 3 6

FLOOR RIDERS. To be sided only to the following dimensions; and so well grown as to have a natural cast over the keelson without being grain-cut.

Gun-sh.		Ft.	In.		In.	Per Load.
100	Length from	31	0	Sided	17	£10 15 5
74	....	28	6	.....	17	9 16 6
50	....	24	6	.....	15	8 7 0

LOWER FUTTOCK RIDERS. To be sided only to the following dimensions. The floor timbers, 1st, 2d, 3d, 4th futtocks, and toptimbers, breasthooks, floor and lower futtock riders, when received are all to be moulded, and the offal or chock timber that would be sawed off to be deducted from the contents of the piece, to reduce it to a converted state; and such chock timber to be paid for at the rate of £3. 12*s*. 6*d*. per load. It is to be observed, that in all the before mentioned moulding timber, the length is to be taken by a straight line from the extremes of the piece, and the round taken from them, and strictly set off accordingly. The length for ascertaining the contents is to be taken at the middle of the piece sideways, according to the form of the converted part.

Gun-sh.		Ft.	In.		Ft.	In.		In.		In.		In.	Per Load.
100	Length from	22	0	to	18	6	Rounding from	36	to	30	Sided to	17	£12 1 6
74	....	20	6	to	17	0	....	30	to	24	.....	16	11 6 0
50	....	18	6	to	15	0	....	24	to	18	.....	14½	10 1 6

WING TRANSOMS. To be sided only to the following dimensions and to a proper round up; or left sufficiently sided to obtain it, which extra siding however is not to be taken into the contents of the piece.

Gun-sh.		Ft.	In.		In.		In.	Per Load.
100	Length	34	0	Round up	4½	Sided to	15	£12 18 6
74	.....	30	6	......	4	.....	13½	10 15 6
50	.....	26	6	......	3½	.....	12½	9 16 6

DECK TRANSOMS. To be sided only, to the following dimensions, and to a proper round-up, or sufficient wood left to obtain it, which is to be abated from the contents of the piece.

Gun-sh.		Ft.	In.		In.	Per Load.
100	Length	32	3	Sided to	14	£12 3 6
74	......	27	6	.....	13	10 17 6
50	......	24	0	.....	12	9 17 6

STERN POSTS. To be sided only to the following dimensions, and of a parallel thickness as far as the piece will hold, at least not less than half its length.

Gun-sh.		Ft.	In.		In.	Per Load.
100	Length	34	0	Sided to	25	£12 18 6
74	.....	32	0	.....	22½	11 18 6
50	.....	29	6	....	21	10 17 0

N. B. Stern-posts, and all other conversions, are to have their full substance the moulding-way.

N. B. On all occasions, the purveyors are to be instructed to set off the lengths and the over lengths (if any) of the timbers, for the guidance of the merchants in cutting off the timber; and they are also to be directed to specify the over lengths in their reports for the officers information on the receipt of the timber.

N. B. Only two-thirds of the contents of the over lengths is to be paid for; and at the same price as the other part of each respective piece.

STANDARDS. To be sided only to the following dimensions, and the arms in proportion to each other, agreeably to the custom of receiving them in his Majesty's yards.

Gun-sh.		Ft.	In.		Ft.	In.		Ft.	In.		In.	Per Load.
100	Length from	7	2	to	6	7	Shortest arm	5	0	Sided to	14	£11 10 6
74	....	7	0	to	6	6	....	4	9	.....	12½	
50	....	6	9	to	6	4	....	4	6	.....	11½	

COMMON KNEES square. To be sided only to the following dimensions, and so far as to gain sufficient spine on the small arm.

	Ft.	In.		Ft.	In.		Ft.	In.		Ft.	In.	Per Load.
Length from	7	6	to	4	0	Shortest arm	5	6	Sided	12	9	£13 2 0
										11½, 11	8½	
										10½	8	
										10	7½	
										9½	7	

COMMON KNEES RAKING. To be sided only to the following dimensions, and great regard to be paid that they are not too much without a square; as many as can be produced for *hanging-knees* of middle, upper, quarter deck, and forecastle beams, to be from seven feet six inches to seven feet the longest arm. Both arms to be equally sided, and so far on as to gain sufficient spine in the small arm for moulding.

	Ft. In.		Ft. In.		Ft. In.		Ft. In.	Sided.	Per Load.
Length from	7 6	to	4 0	Short arm	5 6	to	4 0	12 —9 11½, 11 — 8½ 10½—8 10 —7½ 9½—7	£11 0 6

CHEEKS FOR SHIPS' HEADS. The bow arm only to be sided to the following dimensions, and the knee arm to be fairly grown and rough squared.

Gun-sh.		Ft. In.		Ft. In.			Per Load.
100	Length	13 6	Short arm long	8 0	Sided	14 inches	£11 17 0
74	. . . . .	11 6	. . . .	6 6	. . .	12	9 17 6
50	. . . . .	9 6	. . . .	5 6	. . .	10	8 10 6

KNEES against the STEM on the Gun-deck to be sided only to the following dimensions.

Gun-sh.		Ft. In.		Ft. In.			Per Load.
100	Length	15 6	Short arm long	7 0	Sided	14 inches	£12 8 6
74	. . . . .	14 0	. . . .	6 0	. . .	12	11 10 6
64	. . . . .	13 6	. . . .	5 6	. . .	11	11 1 0

KNEES against the STERN-POST on the Gundeck to be sided only to the following Dimensions.

Gun-sh.		Ft. In.		Ft. In.			Per Load.
100	Length	21 6	Short arm long	7 0	Sided	14½ inches	£13 8 6
74	. . . . .	20 0	. . . .	6 6	. . .	13	12 9 0
50	. . . . .	18 0	. . . .	6 0	. . .	11	11 19 6

WING TRANSOM KNEES to be sided only to the following Dimensions.

Gun-sh.		Ft. In.		Ft. In.			Per Load.
100	Length	22 0	Short arm long	10 0	Sided	14½ inches	£15 8 6
74	. . . . .	18 0	. . . .	8 6	. . .	12½	13 11 0
50	. . . . .	14 6	. . . .	7 6	. . .	11½	12 14 0

Among the Wing Transom Knees, Cheeks for Ships' Heads, and Knees against the Stem and Stern-post, on the gundeck, for any of the classes, if the shortest arms happen to have sufficient bigness to side, but are wanting in length to the longest arm, they are, however, to be sided in a proportional bigness to the said longest arm, and the price in such case to be a mean between what is set against the length of each arm. The shortest arm of any wing transom knee is not to be shorter than seven feet.

Rudder Pieces to be sided only to the following dimensions, and so far as they will hold, but not less than one-third of their length when the wood will not hold to side them half their lengths.

The rudder pieces for 74 gun ships, and upwards, to be received if not more than five feet shorter at the heel than the prescribed length.

No more than six rudder pieces to be received with every 1000 loads of timber.

Gun-sh.		Ft.	Inch.			Per Load. £	s.	d.
100	Length	38	0	Sided	28 inches	12	18	6
74	....	36	0	...	26	11	9	0
56	....	32	6	...	22½	10	6	0

LOWER-DECK BEAMS.

To round 5½ inches in 49 feet length for 100 gun-ships.

		Ft. In.	Length, to Ft. In.	Scarphs long Ft. In.	Thick at the Ends Inch.	Sided Inch.	Moulded Inch.	£.	s.	d.
If in three pieces.	End pieces.	27 0	25 6	11 0	6¾	18	18	10	4	0
		25 6	24 0	10 3				10	0	6
		24 0	22 6	9 6				9	15	6
	Middle pieces.	28 0	27 0	11 0	6¾	19	18	11	18	6
		27 0	26 0	10 3				11	7	6
		26 0	25 0	9 6				11	5	0
If two pieces		29 0	27 6	10 6	6¾	18	18	10	9	6

To round 5 inches in 44 feet length for 74 gun-ships.

		Ft. In.	Length, to Ft. In.	Scarphs long Ft. In.	Thick at the Ends Inch.	Sided Inch.	Moulded Inch.	£.	s.	d.
In three pieces.	End pieces.	24 0	22 6	10 0	6¼	16½	16½	9	11	0
		22 6	21 6	9 6				9	8	6
		21 6	20 6	9 0				9	6	0
	Middle pieces.	27 0	26 0	10 0	6¼	17½	16½	10	12	6
		26 0	25 0	9 6				10	9	6
In two pieces		27 0	25 6	9 6	6¼	16½	16½	9	15	0

To round 4¼ inches in 40 feet length for 50 gun-ships.

		Ft. In.	Length, to Ft. In.	Scarphs long Ft. In.	Thick at the Ends Inch.	Sided Inch.	Moulded Inch.	£.	s.	d.
In three pieces.	End pieces.	22 6	21 0	9 6	5½	14¾	14¾	9	4	6
		21 0	20 0	9 3				9	2	6
		20 0	19 0	9 0				9	1	0
	Middle pieces.	25 0	24 0	9 6	5½	15¾	14¾	10	7	6
In two pieces.		25 0	24 6	9 6	5½	14¾	14¾	9	5	0
		24 6	23 0	9 3						

MIDDLE-DECK BEAMS.

To round 7½ inches in 46 feet length for 100 gun-ships.

		Ft. In	Length, to Ft. In.	Scarphs long Ft. In.	Thick at the Ends Inch.	Sided Inch.	Moulded Inch.	£.	s.	d.
In three pieces.	End pieces.	25 0	24 0	10 0	5½	15½	13½	9	9	6
		24 0	23 0	9 6				9	7	6
		23 0	22 0	9 0				9	5	6
	Middle pieces.	27 0	26 0	10 0	5½	16½	13½	10	12	6
		26 0	25 0	9 6				10	10	6
		25 0	24 0	9 0				10	8	6
In two pieces.		30 0	29 6	9 6	5½	15½	13½	10	0	6
		28 6	27 0	9 0				9	17	6
		27 0	25 6	8 6				9	15	0

To round 7 inches in the length of 44 feet for 90 gun-ships.

		Ft. In.	Length, to Ft. In.	Scarphs long Ft. In.	Thick at the Ends Inch.	Sided Inch.	Moulded Inch.	£.	s.	d.
In three pieces.	End pieces.	24 0	23 0	10 0	5¼	14½	12¾	9	6	0
		23 0	22 0	9 6				9	4	6
		22 0	21 0	9 0				9	0	0
	Middle pieces.	27 0	26 0	9 6	5¼	15¼	12¾	10	7	6
		26 0	25 0	9 0				10	5	6
		25 0	24 0	8 6				10	2	6

	Ft. In.	Length, to (Ft. In.)	Scarphs long (Ft. In.)	Thick at the Ends (Inch.)	Sided (Inch.)	Moulded (Inch.)	£.	s.	d.
In two pieces	29 0	27 6	9 0	5¼	14½	12¾	9	17	6
	27 6	26 0	8 6				9	15	0
	26 0	24 6	8 0				9	12	6

UPPER-DECK BEAMS.

To round 8½ inches in 38 feet length for 100 gun-ships.

	Ft. In.	Length, to (Ft. In.)	Scarphs long (Ft. In.)	Thick at the Ends (Inch.)	Sided (Inch.)	Moulded (Inch.)	£.	s.	d.
If in three pieces. End pieces.	21 0	19 0	9 0	4¾	13½	11½	8	15	0
	19 0	18 0	8 6				8	13	0
Middle pieces.	26 0	25 0	9 0				9	19	6
	25 0	24 0	8 6	4¾	14½	11½	9	18	6
In two pieces	27 0	26 0	9 0				9	10	6
	26 0	25 0	8 6	4¾	13½	11½	9	8	6
	25 0	24 0	8 0				9	7	0

To round 7¾ inches in 40 feet 6 inches length for 74 gun-ships.

	Ft. In.	Length, to (Ft. In.)	Scarphs long (Ft. In.)	Thick at the Ends (Inch.)	Sided (Inch.)	Moulded (Inch.)	£.	s.	d.
In three pieces. End pieces.	22 0	21 0	9 0	4½	14	12¼	8	15	0
	21 0	20 0	8 6				8	13	6
Middle pieces.	26 0	25 0	9 0				9	19	6
	25 0	24 0	8 6	4½	15	12¼	9	18	6
If two pieces	27 6	26 6	9 0				9	11	6
	26 6	25 0	8 6	4½	14	12¼	9	9	6
	25 0	24 0	8 0				9	7	6

To round 7¼ inches in 34 feet length for 50 gun-ships.

	Ft. In.	Length, to (Ft. In.)	Scarphs long (Ft. In.)	Thick at the Ends (Inch.)	Sided (Inch.)	£.	s.	d.
In three pieces. End pieces.	18 6	17 6	8 0	4½	12½	8	12	0
Middle pieces.	25 0	24 0	8 0	4½	13½	9	10	0
In two pieces	24 0	20 0	8 0			9	4	0
	23 0	22 0	7 8	4½	12½	9	2	6
	22 0	21 0	7 8			9	1	6

QUARTER-DECK AND FORECASTLE BEAMS.

To round 9 inches in 34 feet 6 inches length for 100 gun-ships.

	Ft. In	Length, to (Ft. In.)	Scarphs long (Ft. In.)	Thick at the Ends (Inch.)	Sided (Inch.)	£.	s.	d.
Half	24 0	22 6	7 0	4	10	9	1	0
	26 6	20 6	6 9			8	18	0
Whole	28 0	26 6				10	6	6
	26 6	25 0				10	1	0

To round 8 inches in 34 feet length for a 74 gun-ship.

	Ft. In.	Length, to (Ft. In.)	Scarphs long (Ft. In.)	Thick at the Ends (Inch.)	Sided (Inch.)	£.	s.	d.
Half	23 6	22 0	7 0	4	9½	8	19	6
	22 0	20 6	6 9			8	16	6
Whole	28 0	26 0				10	0	6
	26 0	24 0				9	11	6

To round 7¼ inches for 29 feet 6 inches length for a 50 gun-ship.

	Ft. In.	Length, to (Ft. In.)	Scarphs long (Ft. In.)	Thick at the Ends (Inch.)	Sided (Inch.)	£.	s.	d.
Half	22 0	21 6	6 9	4	8½	8	13	0
	21 6	20 6	6 3			8	11	6
Whole	27 0	25 0				9	5	0
	25 0	23 0				9	2	0

All pieces designed for Stern-posts, Stems, Rudders, and Keelsons, which are directed to be sided of a parallel thickness, are to be lined, or a mould applied to distinguish the converted part from the offal or chock timber; thereby to ascertain the respective contents and value of each piece, for which the contractor is to be paid the prices stipulated for such conversion in the foregoing contract, and for the offal or chock timber at the rate of £3. 12*s.* per load.

And, that the greatest advantage may be taken in the conversion of Beam pieces, (end as well as middle pieces) for Lower, Middle, and Upper-deck, beam pieces, are to be cut the moulding way, agreeably to the roundings given in the foregoing dimensions; and, on their being received into the yards, to be lined only the sided way, with proper tails and scarphs, that the slabs to be sawn off may be paid for as chock timber.

All the moulding timbers for the frame (as well as other) to be left the moulding way the same as directed by the converted contract, and as much bigger as the person attending the receipt of it may see necessary for moulding and bevelling wood, (particularly the frame timber, for the fore and after parts of the ship) and the beam pieces may be sided half an inch, and moulded one inch more than their respective scantlings, where the wood will allow, and such increase of scantling to be taken into the contents of the converted part of the piece. *Note.* To all these prices there is an advance of six pounds per cent. on every article.

Lastly, By *Thickstuff* is meant timber, cut into different thicknesses, from ten inches down to four inches and a half; but the whole depth of the timber the other way; and by *Plank* is meant that which runs from four inches down to one inch and a half in thickness; all under these dimensions is termed *Board.*

Thickstuff and Plank are generally served from the merchants sided to the various thicknesses, and mostly cut in the wood or forest where it grows. It is cut straight, and fairly edged, of parallel breadths, of whatsoever the piece will hold square and free from sap, at half the length of the piece, not exceeding nineteen inches nor less than twelve inches.

The quantity of Thickstuff to be delivered into the King's yards is, ten loads to every hundred load of straight oak timber. Fifteen loads of four-inch oak plank, and ten loads of three-inch, to be delivered to every hundred loads of straight oak timber.

When measured, the superficial contents only are taken, which is done by measuring the breadth exactly in the middle, and multiplying that by the whole length, then the number of superficial feet in a load is according to the thickness of the different plank or thickstuff, and may be found as follows:

Rule.—Divide 12 by the thickness, and multiply the quotient by 50, as per example.

```
8)12
 ----
  1. 6
  50
  ----
  50
  25
  ----
  75
```

75 As may be seen by the following Table.

Thickness of the Thickstuff or Plank	Inch. 10	Inch. 9	Inch. 8	Inch. 7	Inch. 6	Inch. 5	Inch. 4	Inch. 3	Inch. $2\frac{1}{2}$	Inch. 2	Inch. $1\frac{1}{2}$
Number of superficial feet to a load	Feet. 60	Feet. 66.66	Feet. 75	Feet. 85.71	Feet. 100	Feet. 120	Feet. 150	Feet. 200	Feet. 240	Feet 300	Feet. 400

	Length.		Feet.		Feet.	Broad to hold at those lengths. Inch.	To be measured as far as it will hold. Inch.	Price per Load. £.	s.	d.
THICKSTUFF for CLAMPS.	10, 9, 8, 7, 6, 5	metings	30	lowest	26;	14	9	11	10	0
For SPIRKETTINGS and WALES.	10, 9, 8, 7, 6, 5	metings	28	lowest	23	13	9			
ENGLISH OAK PLANK.	$4\frac{1}{3}$		28		24	12	$10\frac{1}{2}$	10	10	0
	$4\frac{2}{3}$		23		20	10	9			
	3		26		22	11	10	9	10	0
ELM.	4		28		23	12	11	5	0	0
	3		24		20	11	10	4	0	0
BEECH.	4		28		24	13	12	4	10	0
	3		26		22	12	11	3	10	0
OAK BOARD	1		18		12	10	9	Per Hundred Feet. 0	13	0
								0	18	0
ELM BOARD	$1\frac{1}{4}$, $1\frac{3}{4}$		18		12	10	9	0	15	0

BOATS' CROOKS, £3. 3s. per Load.

DANTZIC OAK PLANK, of all thicknesses, £13. 15s. per Load, and £9 per cent. added.

6. TO MEASURE AND COMPUTE THE SOLIDITY OF THICKSTUFF AND PLANK, AS RECEIVED INTO THE KING'S AND OTHER YARDS.

RULE. Multiply the whole length of the plank by the breadth taken correctly in the middle, and the product will be the superficial contents: then, to find the solidity or number of loads contained therein, look for the thickness of plank or thickstuff, in the foregoing table of plank, under which will be found the divisor for dividing the superficial contents in feet, in order to give the solidity in loads.

EXAMPLE 1.

Required, the number of loads contained in a piece of 10-inch thickstuff, the length of which is 49 feet, and the breadth, taken in the middle, 1 foot 9 inches.

49 feet × by 1 foot 9 inches is 85 feet 9 inches, which ÷ by 60 is 1 load 25 feet.

EXAMPLE 2.

Suppose that there are ten planks of $2\frac{1}{2}$ inches thickness, each measuring 24 feet in length, and 13 inches broad in the middle, required the number of loads contained therein?

24 feet × by 1 foot 1 inch is 26 feet, which × by 10 is 260 feet superficial contents. Then 260 feet divided by 240 is equal to 1 load 20 feet, the solidity required.

BY THE SLIDING RULE.

As 12 on the slider is to the *breadth* on the rule, so is the *length* on the slider to the *contents* on the rule.

In the foregoing examples are contained all the cases that generally occur in the admeasuring of timber for sale: but, when timber is regularly and smoothly hewn, the solidities of such pieces had best be computed by the rules given for prisms, pyramids, cones, &c. and their frustums; for which the reader may refer to the best books on that subject.

Many curious problems, relating to the cutting of timber, so as to produce uncommon effects, may be found in Dr. Hutton's large Treatise on Mensuration.

In converting timber in the forest, great care should be taken to preserve it as large and as circular as possible, from a consideration of the great use of large and compass timber; but it should be observed, at the same time, to adhere to the custom of squaring it by the rule before mentioned, as, if not so squared, the detriment would not only be in the false measure, but the defects which might appear were the timber truly squared might remain unseen. And, as the defects in timber are of the utmost consequence, it should always be well examined when received or purchased, that the buyer may have an opportunity of having something abated in proportion to the nature of the defect. The defects in timber are various, but it is chiefly owing to the barrenness of the soil, as in loose and broken ground the timber is generally shaky, which is a very pernicious defect.

Lopping of timber, or the suffering of cattle to browse upon it, often occasions it to rot and decay. But the greatest enemies to the growth of young timber are rabbets; for, where there is a number of these animals, a spontaneous shoot can no sooner appear above the ground but it is destroyed. Sound timber is generally produced in those places where the earth consists of strong clay; for which reason, timber of English growth is found to be so far preferable to that of other countries; for, though some of the best sort of East-country plank is very flexible, and consequently useful for many purposes; yet it is often found very unserviceable, as it is, too frequently, either shaken, foxey, druxy, worm-eaten, or full of rotten knots; therefore, timber of English growth certainly has the preference, even after it has stood so long that age has made it pliable, and past the time allowed for growth, as it is even then allowed to be as durable as any other in its full strength.

TREENAILS. To be of dry seasoned English oak, of the growth of Sussex, cut full out of young, clung, tough coppice timber, or other timber equal in goodness thereto.

PRICE OF TREENAILS.

Length. Feet.	Price per Thousand. £.	s.	d.	Number to a Load.
48	35	7	0	1000
42	29	7	0	1142
39	23	9	9	1236
36	18	7	6	1333
33	15	10	0	1454
30	12	12	6	1600
27	9	17	9	1777
24	7	11	3	2000
21	5	10	9	2285
18	3	12	6	2666
15	2	11	9	3200
12	1	19	0	4000

£. 22 per Cent. has been added to the above prices.

PRICE OF FIR TIMBER.

	£.	s.	d.
Dantzic	7	10	0
Riga	7	8	0
Baulk, First sort	4	12	0
Baulk, Second sort	4	0	0
Norway or Load Baulk	5	5	0

PRICE OF DEALS.

Prussia	Long.	Each. £.	s.	d.
Thick. 3 In.	40	1	10	0
	38	1	9	0
	36	1	8	0
	34	1	7	0
Thick. 2½ In.	40	1	4	0
	38	1	2	6
	36	1	1	6
	34	1	0	0
	30	0	19	0
Thick. 2 In.	38	1	0	0
	36	0	19	0
	34	0	18	6
	30	0	17	6
	29	0	17	0

ORDINARY DEALS PER HUNDRED, AND SIX SCORE TO THE HUNDRED.

	Feet.	£.	s.	d.
Long.	13½ . . .	22	0	0
	11½ . . .	20	0	0
	9½ . . .	18	10	6

	Long.	£.	s.	d.
		Each.		
UPHROES	34 . . .	0	7	9
	28 . . .	0	5	6

PRICE OF COPPER.

	£.	s.	d.	
Bolts and Rings . :	0	1	3½	per ℔
Sheets, improved sort	0	1	2¾	
Sheets, common	0	1	2½	
Nails, for sheathing	0	1	3½	
Nails for Boats, one with another	0	1	5	

PRICE OF IRON.

	£.	s.	d.	
Iron Bolts	1	17	4	per Cwt.
Bolt Staves . . .	1	11	4¼	

The foregoing prices are those of the year 1804—They have since considerably increased.

TABLES,

&c.

TABLES

FOR

FORMING THE BODIES

OF

SHIPS AND VESSELS OF EACH CLASS,

BOTH IN THE

ROYAL NAVY AND IN THE MERCHANT SERVICE.

BODIES OF THE SHIP OF 110 GUNS AND $2358\frac{21}{94}$ TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers......	⊕		A		E		I		N		R		W		Y		&		& 2	
	ft.	*in.*	*ft.*	*in*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
Station from the foremost perpendicular........	87	8	76	6½	65	5	54	3½	43	2	32	0½	20	11	15	4¼	9	9½	4	2¾
Lower height of breadth........................	22	0	22	0½	22	2	22	7	23	3½	24	4	25	10½	27	1	28	8	31	9½
Upper height of breadth........................	24	3	24	3	24	3½	24	4	24	5	25	2½	26	5½	27	6	28	11½	31	11
Height of the top-timber line..................	45	6	45	6	45	6½	45	7	45	10	46	2	46	10	47	3½	47	9		
topside line........................	...		...		...		...		48	7	48	11	49	7	50	0½	50	6		
cutting down line...................	1	9	1	9	1	11	2	1½	2	3½	2	9½	4	5	6	3	9	7		
rising line.........................	0	5	0	5½	0	6½	0	10½	1	3½	2	5	5	2½	8	2½	15	5		
Main half-breadth..............................	26	0	26	0	25	11½	25	11	25	10	25	3½	23	9	22	1	19	2	13	10½
Top-timber half-breadth........................	21	8	21	8	21	7½	21	7	21	6	20	10½	19	11	19	4	18	5½	17	5½
Topside half-breadth...........................	...		...		...		21	1	21	0	20	5½	19	9½	19	4	18	5½	17	5½
Rising half-breadth............................	10	7	10	6¼	10	6	10	5½	10	3	9	7	7	6	5	5½				
Length of the lower breadth sweep..............	25	0	24	0	23	4	22	10	22	7½	21	3½	19	2	17	7½	15	7	12	6½
upper breadth sweep............	25	0	25	0	25	0	25	0	25	0	25	0	25	0	25	0	25	0	25	0
floor sweep above the rising.....	12	6	12	6	12	6	12	6	12	6	12	6	12	6	12	6				
Length on the first diagonal line..............	15	6	15	6	15	5	15	3	14	10	14	1	11	10½	9	7	6	0		
second diagonal line............	22	4	22	4	22	3	22	0	21	4	20	0½	16	8	13	10	9	9	4	2
third diagonal line.............	26	3	26	3	26	2½	26	0	25	5½	24	0½	20	9	17	8½	13	4½	7	6½
fourth diagonal line............	29	4½	29	4½	29	4¼	29	2	28	7½	27	8	24	6½	21	7	17	6½	11	6
fifth diagonal line.............	31	7½	31	7½	31	7½	31	5½	31	0	30	2¼	27	6½	24	11½	21	3	15	1½
sixth diagonal line.............	27	0	27	0	27	0	27	0	26	11½	26	4	25	0	23	4	20	8½	16	8½

IN THE FORE AND AFTER BODIES.

Names of the Diagonals................................	1st		2d		3d		4th		5th		6th	
Height up the middle line.........................	12	11	17	5½	21	10	27	6½	33	6	41	9
Distance from the middle line on the base line or upper edge of the rabbet..................	9	4½	17	6								
Height up the side line	...		...		0	9½	6	7	12	5	35	9

IN THE AFTER BODY.

Numbers of the Timbers.........................	(4)		4		8		12		16		20		24		28		30		32	
Station from the after perpendicular............	94	2½	83	1	71	11½	60	10	49	8½	38	7	27	5½	16	4	10	9¼	5	2½
Lower height of breadth........................	22	1	22	3	22	6	22	9	23	2	23	9½	24	7½	26	0½	27	2½	28	6½
Upper height of breadth........................	24	3	24	3	24	3½	24	4	24	5	24	10½	25	5½	26	6½	27	6½	28	9½
Height of the top-timber line..................	45	6	45	7	46	0	46	8	47	4	48	0	49	0	50	3½	51	0	51	8½
topside line........................	...		49	1	50	10	51	6	52	2	54	3	55	3	56	6½	57	3	57	11½
cutting down line	1	9	1	9	1	10½	2	3	2	10	3	9	5	1½	7	7	9	5½	12	2½
rising line........................	0	5	0	6½	0	9½	1	2½	1	11	3	4	5	11½	10	0				
Main half-breadth..............................	26	0	26	0	26	0	25	10	25	7	25	1½	24	4½	23	2	22	1½	20	6½
Top-timber half-breadth........................	21	8	21	8	21	6½	21	4	20	10½	20	4½	19	9	18	9½	17	10½	16	9½
Topside half-breadth...........................	...		21	2½	21	0	20	10	20	4½	19	10½	19	2½	18	3	17	4	16	3
Rising half-breadth............................	10	7	10	5½	10	2¾	9	7	8	8½	7	3½	5	6½						
Lengths of the lower breadth sweep.............	25	0	24	0	23	5	22	9	21	6	20	0	17	8½	14	7	11	7	6	2
upper breadth sweep............	25	0	25	0	25	0	25	0	25	0	25	0	25	0	25	0	25	0	25	0
floor sweep above the rising.....	12	6	12	6	12	6	12	6	12	6	12	6	12	6						
Length on the first diagonal line	15	6	15	4	15	1	14	8	13	11	12	9	11	0	8	6	6	6½	4	3
second diagonal line............	22	4	22	1	21	8½	21	1½	20	0	18	2	15	5½	11	11½	9	5	5	9½
third diagonal line..............	26	3	25	11	25	7½	25	1½	24	1¼	22	4½	19	10½	15	10½	12	9½	8	1½
fourth diagonal line.............	29	4	29	0¾	28	9¾	28	5¾	27	7	26	4¼	24	3½	20	9	17	8	12	3½
fifth diagonal line...............	31	7	31	5	31	3¼	31	0¾	30	5½	29	7¾	28	0¾	25	7	23	2	18	3
sixth diagonal line...............	27	0	27	0	27	0	26	11	26	7	26	2½	25	5	24	4	23	1½	21	8

BODIES OF THE SHIP OF 98 GUNS AND 2067 $\frac{6}{94}$ TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers......	⊕		B		F		K		O		S		X		Y	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
Station from the foremost perpendicular........	82	8	65	10	54	8	43	6	32	4	21	2	10	0	7	2½
Lower height of breadth	18	4	18	4½	18	9	19	5	20	9	22	11	26	5	27	7
Upper height of breadth..........................	22	4	22	4	22	4	22	5½	23	1	24	7	27	5	28	4
Height of the top-timber line	42	10	42	10	42	11	43	2	43	6	44	0	44	8	44	10
topside line........................	...		...		...		...		44	11	45	5	46	3	46	5
cutting down line.................	1	8	1	8	1	10	2	2	3	0	4	5	7	9		
rising line.....	0	5	0	5¾	0	9	1	6	3	1	5	8½	10	1		
Main half-breadth..................................	24	6	24	6	24	6	24	3½	23	8½	22	1	17	8	15	5
Top-timber half-breadth..........................	20	0	20	0	19	11½	19	9½	19	5	18	8	17	5½	17	0
Topside half-breadth..............................	...		...		...		...		19	9	18	11	17	5½	17	0
Rising half-breadth	9	8	9	7	9	3	8	5	6	11	4	6	0	8		
Length of the lower breadth sweep.............	17	6	17	6	17	3½	16	0	13	1	11	5½	11	4½	11	11
upper breadth sweep............	19	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0
floor sweep above the rising.....	11	3	11	3	11	3	11	3	11	3	11	3	11	3		
Length on the first diagonal line................	9	7½	9	6½	9	3½	8	10	8	0½	6	5½	2	4½	0	8
second diagonal line.............	15	11	15	9½	15	4	14	5½	13	0½	10	7½	5	11	4	1
third diagonal line...............	20	7	20	6¼	19	11½	18	10½	16	11	13	10½	8	7	6	8½
fourth diagonal line	23	11	23	9¼	23	3	22	4	20	3¼	17	0	11	5¼	9	4½
fifth diagonal line	26	4¼	26	1½	25	9½	24	11	23	1½	20	0½	14	4½	12	0
sixth diagonal line...............	27	5	27	3	26	11	26	4½	24	11½	22	1½	16	6	13	10

IN THE FORE AND AFTER BODIES.

Names of the Diagonals..................................	1st		2d		3d		4th		5th		6th	
Height up the middle line	7	6	12	5½	16	2½	20	0	23	9½	26	2
Distance from the middle line on the base line or upper edge of the rabbet	6	6	10	9	15	7	21	2½				
Height up the side line............................	...		...		...		...		2	10	10	3

IN THE AFTER BODY.

Numbers of the Timbers.........................	1		5		9		13		17		21		25		29		31	
Station from the after perpendicular............	88	1	76	11	65	9	54	7	43	5	32	3	21	1	9	11	4	4
Lower height of breadth..........................	18	4	18	4	18	8	19	2	20	0	21	5	23	3	26	1	27	10
Upper height of breadth..........................	22	4	22	4	22	5	22	10	23	4	24	3	25	5	27	2	28	4
Height of the top-timber line.....................	42	11	43	2	43	6½	44	1	44	9	45	6	46	8	47	6	48	1
topside line........................	...		...		47	6½	48	1	48	9	49	6	51	10	52	8	53	3
cutting down line.................	1	8	1	10	2	0	2	4	3	0	4	2	6	0	9	6	12	4
rising line	0	5½	0	10	1	6	2	6¾	4	1¼	6	6¼	9	11	15	0		
Main half-breadth..................................	24	5¾	24	3½	22	11½	23	6	22	9	21	8	20	2	18	3½	17	2
Top-timber half-breadth..........................	20	1	19	11½	19	9½	19	6	19	0	18	4	17	6½	16	6	15	10
Topside half-breadth..............................	...		19	4½	19	2½	18	11	18	5	17	9	16	10½	15	10	15	2
Rising half-breadth................................	9	7	9	5	9	0¾	8	4½	7	3¼	5	8	3	8	1	1		
Length of the lower breadth sweep.............	17	0	16	9	15	8½	14	8	13	6	12	2½	10	8	8	2	6	0
upper breadth sweep............	19	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0	19	0
floor sweep above the rising....	11	3	11	3	11	3	11	3	11	3	11	3	11	3	11	3		
Length on the first diagonal line................	9	7½	9	3½	8	10½	8	2	7	1½	5	9	4	2	2	2	1	1½
second diagonal line............	15	10	15	3½	14	6¾	13	6½	11	11	9	9½	7	4	4	1	2	1
third diagonal line...............	20	6	20	0½	19	2	17	10	15	10½	13	3	10	2	5	11	3	2½
fourth diagonal line..............	23	10½	23	6	22	9	21	6½	19	8	16	10½	13	5½	8	8½	5	2½
fifth diagonal line................	26	2½	25	10½	25	4¼	24	4½	22	10¼	20	4	16	11½	12	0	8	1
sixth diagonal line...............	27	2½	26	11	26	6¼	25	9¼	24	7	22	8	19	10	15	1	10	9½

BODIES OF THE 80-GUN SHIP, OF TWO DECKS, 1955 TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers......	⊕		D		H		M		Q		U		X	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
Station from the foremost perpendicular........	64	0	53	1	42	2	31	3	20	4	9	5½	4	0
Lower height of breadth........................	22	6	22	6½	22	9½	23	4¾	24	8	26	11	28	8
Upper height of breadth	24	10	24	10½	24	11½	25	2	25	9½	27	5	28	11
Height of the top-timber line....................	37	6	37	9	38	2	38	9	39	6	40	4	40	10
topside line........................	...		40	3	40	8	41	3	42	0	42	10	43	4
cutting down line................	2	3	2	3	2	4½	3	1½	4	11	8	5		
rising line *........................	11	10	1	9	6	5	13	9						
Main half-breadth................................	24	6	24	6	24	4	23	10	22	1¼	17	2	11	3
Top-timber half-breadth..........................	21	0	21	0	20	9½	20	4	19	5½	17	10	16	7
Topside half-breadth..............................	...		20	4½	20	3	19	10½	19	2½	17	10	16	7
Rising half-breadth................................	8	6	7	6	4	11	0	3½	Outside the middle line.					
Length of the lower breadth sweep............	19	2	18	8	17	10	16	9	15	3	13	3	12	1
upper breadth sweep............	15	3	15	3	15	3	15	3	15	3	15	3	15	3
floor sweep above the rising.....	See rising line.													
Length on the first diagonal line................	7	11	7	9	7	5	6	11	5	4	1	1		
second diagonal line............	13	9	13	5	12	9	11	6	9	3	4	5		
third diagonal line..............	20	1	19	7	18	5	16	7	13	6½	8	2½	3	4
fourth diagonal line............	23	6	23	2¼	22	4¼	20	6¼	17	3	11	6	6	3½
fifth diagonal line..............	24	9	24	5¾	24	0	22	6¼	19	9	13	9	8	3
sixth diagonal line..............	26	3½	26	2½	25	9	24	11	22	7	16	8½	10	9½

IN THE FORE AND AFTER BODIES.

Names of the Diagonals........................	1st		2nd		3d		4th		5th		6th	
Height up the middle line................	6	11	11	5	16	6	20	9	23	6	27	6
Distance from the middle line on the base line or upper edge of rabbet.....	4	9	9	1	15	6						
Height up the side-line..................	...		...		...		0	9	6	8	12	8

IN THE AFTER BODY.

Numbers of the Timbers..........................	4		8		12		16		20		24		28		32		36		38	
Station from the after perpendicular...........	96	2	85	3	74	4	63	5	52	6	41	7	30	8	19	9	8	10	3	4½
Lower height of breadth	22	6	22	6	22	6	22	7½	22	10	23	3	23	11½	25	0¾	26	10½	28	2
Upper height of breadth	24	10	24	10	24	10	24	11	25	1½	25	6	26	0	26	9	27	9½	28	8
Height of the top-timber line....................	37	6	37	7	37	10	38	2½	38	8½	39	4	40	2	41	0¾	42	1	42	7½
topside line.........................	...		40	9	41	11	42	4	42	10	43	5	46	3	47	2	48	2	48	9
cutting down line...............	2	3	2	3½	2	3¼	2	4	2	5¾	2	11	4	2½	6	8½	9	8½		
rising line *........................	0	4½	1	2½	2	6½	4	7	7	10	13	3								
Main half-breadth................................	24	6	24	5	24	3¾	24	2¾	24	0	23	6	22	7½	21	4¾	19	7½	18	5
Top-timber half-breadth..........................	21	0	20	11	20	10	20	9	20	7	19	11	18	11	17	6	15	11	15	1
Topside half-breadth..............................	...		20	2	19	10	19	10½	19	8½	19	2½	17	9	16	6½	14	11	14	1
Rising half-breadth................................	8	5¾	8	1	7	5½	6	4	4	3	0	6								
Length of the lower breadth sweep............	19	2	18	10½	18	4	17	8	16	9	15	5	13	9	11	6½	8	0	5	2
upper breadth sweep............	15	3	15	3	15	3	15	3	15	3	15	3	15	3	15	3	15	3	15	3
floor sweep above rising.........	See rising line.																			
Length on the first diagonal line................	7	11	7	10½	7	8	7	4	6	11	6	2½	5	3	3	10¼	1	9	0	9½
second diagonal line............	13	9	13	7	13	1½	12	7	11	8½	10	4	8	8½	6	4	3	1	1	1
third diagonal line..............	20	1	19	10½	19	4	18	6½	17	5½	15	3	12	11	9	10¼	5	7	2	2
fourth diagonal line............	23	6	23	4	23	0	22	3½	21	2½	19	4½	16	11	13	5	8	7½	4	2¾
fifth diagonal line..............	24	9	24	7½	24	5½	23	10½	23	1½	21	10	19	8	16	5	11	6	6	9½
sixth diagonal line..............	26	3½	26	2½	26	0½	25	9½	25	4	24	6	22	11	20	5	16	1	11	6

* Rising height is 11 feet 10 inches at dead-flat, above which all the other rising heights must be set off.

BODIES OF THE SHIP OF 74 GUNS AND 1828 TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers......	⊕		B		F		K		O		S		U		X	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
Station from the foremost perpendicular........	66	0	60	6	49	6	38	6	27	6	16	6	11	0	5	6
Lower height of breadth..........................	21	3	21	3	21	4	21	8¾	22	7¾	24	3¼	25	5½	27	1
Upper height of breadth..........................	23	4	23	4	23	4¼	23	5½	24	0	25	3	26	2½	27	6
Height of the top-timber line..........	35	4	35	5	35	8	36	0¾	36	6½	37	2	37	6½	38	0
topside line	...		...		57	10	38	2¾	38	8½	39	4	39	8½	40	2
cutting down line	1	10	1	10	1	10¾	2	2	2	10¾	4	8	6	6		
rising line *.........................	11	6	0	4	3	6¼	9	10¾								
Main half-breadth................................	24	0	24	0	24	0	23	10¾	23	0	20	3¼	17	5¼	12	6
Top-timber half-breadth............................	20	8	20	8	20	8	20	5½	19	11	18	8½	17	8¼	16	3¼
Topside half-breadth..............................	20	3	20	3	20	3	20	1½	19	8	18	7½	17	8¼	16	3¼
Rising half-breadth	8	6	8	4¼	8	9	2	8								
Length of the lower breadth sweep	18	6	18	4	18	0	17	0	15	7	14	0	13	0	12	0½
upper breadth sweep............	15	0	15	0	15	0	15	0	15	0	15	0	15	0	15	0
floor sweep above the rising ....'	See rising line.															
Length on the first diagonal line	8	1¾	8	1½	8	0	7	7¾	6	10½	4	11	2	11		
second diagonal line.............	12	10½	12	9½	12	4¼	11	5½	9	10¾	7	3½	5	2	1	9
third diagonal line...............	17	6	17	4¼	16	7½	15	2¾	13	0	9	9½	7	4½	3	5½
fourth diagonal line..............	21	0¼	20	11¼	20	5¼	19	0¼	16	5½	12	6¾	9	9½	5	7½
fifth diagonal line................	21	11¾	21	11	21	7½	20	7¼	18	3¼	14	4	11	2	6	9
sixth diagonal line................	22	9¾	22	9¼	22	7	21	10½	20	0¼	16	1½	12	8½	7	11½

IN THE FORE AND AFTER BODIES.

Names of the Diagonals	1st		2d		3d			4th		5th		6th			4th		5th		6th	
Height up the middle line...............	7	8	10	9	13	8¾	In the Fore Body.	16	5¾	17	10	19	2	In the After Body.	21	9	24	8	27	1¾
Distance from the middle line on the base line or upper edge of the rabbet......	3	10	8	0½	13	0½		...		...		...			22	3½				
Height up the side line	...		...		...			0	3½	5	1¾	6	6½		...		3	10½	8	5¾

IN THE AFTER BODY.

Numbers of the Timbers.........................	4		8		12		16		20		24		28		32		34		36	
Station from the after perpendicular............	93	6	81	2	70	2	59	2	48	2	37	2	26	2	15	2	9	8	4	2
Lower height of breadth..........................	21	3	21	3	21	3½	21	5	21	8¾	22	4	23	3	24	7¼	25	5½	26	5½
Upper height of breadth..........................	23	4	23	4¼	23	5	23	6	23	8½	24	0½	24	7½	25	6	26	1	26	9¼
Height of the top-timber line....................	35	4	35	6½	35	9¾	36	2¼	36	8¾	37	4¾	38	2¼	39	1½	39	8	40	2¾
topside line.........................	...		38	6½	39	3¾	39	8¼	40	2¾	42	0¾	42	10¼	43	9½	44	4	44	10¾
cutting down line	1	10	1	10	1	10¾	2	0¾	2	5¾	3	3¼	4	8½						
rising line *.........................	0	5½	1	4½	2	6½	4	8½	8	0	13	0								
Main half-breadth.................................	24	0	23	11½	23	11	23	8¾	23	3	22	6	21	5	19	11	18	10¾	17	7½
Top-timber half-breadth...........................	20	8	20	8	20	6½	20	4¼	19	11¼	19	2	18	0½	16	7½	15	9½	14	10¾
Topside half-breadth	20	3	19	10½	19	9	19	7	19	3	18	6	17	3	15	9	14	11	14	2
Rising half-breadth	8	4	8	0	7	4	6	2	4	1¾	0	8								
Length of the lower breadth sweep.............	18	6	18	4	18	3	17	8	16	6¾	15	1½	13	3¼	11	0	9	2½	6	9½
upper breadth sweep.............	15	0	15	0	15	0	15	0	15	0	15	0	15	0	15	0	15	0	15	0
floor sweep above the rising.....	See rising line.																			
Length on the first diagonal line.................	8	1¾	8	1½	8	0¼	7	9	7	3¼	6	5	5	2½	3	6¾	2	6	1	2
second diagonal line............	12	10½	12	8⅞	12	4¾	11	9¼	10	10¼	9	5½	7	6¼	5	0	3	4½	1	6½
third diagonal line..............	17	6	17	2¾	16	8¼	15	11	14	8¼	12	10¾	10	3½	7	0½	4	10½	2	3½
fourth diagonal line............	24	4	24	3	23	10½	23	1¼	22	0¼	20	2½	17	5¼	13	10	11	4½	7	7½
fifth diagonal line................	25	10	25	9½	25	6¼	25	0	24	1	22	5½	20	0	16	8½	14	3½	10	5
sixth diagonal line...............	26	9¾	26	9¼	26	7	26	2	25	4¼	24	0	22	0½	19	2	16	11½	13	7¼

* Rising height is 11 feet 6 inches at dead flat; above which, all the other rising heights must be set off.

BODIES OF THE SHIP OF 64 GUNS AND 1369 TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers……	⊕	B	F	K	O	S	U	X
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
Station from the foremost perpendicular……	66 0	56 0	46 0	36 0	26 0	16 0	11 0	6 0
Lower height of breadth……	16 9	16 10	17 1	17 10	19 0	20 7	21 6	22 6
Upper height of breadth……	19 6	19 6	19 8	20 1	20 8	21 3	22 0	22 10
Height of the top-timber line……	32 9	32 10	32 11	33 7	34 2	34 10	35 3	35 9
topside line……	…	…	…	35 11	36 6	36 11	37 6	38 0
cutting down line……	1 9	1 9	1 9	1 9	2 0	3 9	5 6	
rising line.								
Main half-breadth……	21 10	21 10	21 10	21 6	20 5	17 0	14 0	9 6
Top-timber half-breadth……	17 3	17 3	17 1	16 8	16 0	15 0	14 1	13 0
Topside half-breadth.								
Rising half-breadth.								
Length of the lower breadth sweep……	15 6	15 1	14 9	11 8	8 11	9 3	9 0	8 0
upper breadth sweep……	14 9	14 9	14 9	14 9	14 9	14 9	14 9	14 9
floor sweep above rising.								
Length on the first diagonal line……	11 6	11 4	11 0	10 5	8 9	6 2	4 2	1 2
second diagonal line……	16 0	15 11	15 6	14 3	12 0	8 4	5 7	2 2
third diagonal line……	19 6	19 5	18 11	17 8	15 7	11 4	8 1	4 3
fourth diagonal line……	21 9	21 9	21 6	20 2	18 3	13 11	10 9	6 6
fifth diagonal line……	23 9	23 9	22 8	22 9	21 0	17 4	14 2	9 8

IN THE FORE AND AFTER BODIES.

Names of the Diagonals……	1st	2d	3d	4th	5th
Height up the middle line……	8 11	11 4	14 8	17 11	23 4
Distance from the middle line on the base line or upper edge of rabbet……	8 9	17 9			
Height up the side line……	…	…	2 5	7 7	13 2

IN THE AFTER BODY.

Numbers of the Timbers……	(2)	3	7	11	15	19	23	27	31
Station from the after perpendicular……	88 6	77 10½	67 10½	57 10½	47 10½	37 10½	27 10½	17 10½	7 10½
Lower height of breadth……	16 9	16 11	17 2	17 7	18 2	18 11	19 11	21 10	24 4
Upper height of breadth……	19 6	19 6	19 6	19 6	19 11	20 6	21 5	22 8	24 9
Height of the top-timber line……	32 9	32 10	33 2	33 7	34 2	34 11	35 8	36 6	37 9
topside line……	…	…	36 11	37 4	39 9	40 5	42 5	43 6	44 7
cutting down line……	1 9	1 9	1 10	2 0	2 6	3 0	4 0	6 6	11 0
rising line.									
Main half-breadth……	21 10	21 10	21 9	21 5	20 9	20 0	18 9	17 5	15 10
Top-timber half-breadth……	17 3	17 2	17 0	16 9	16 6	15 11	15 3	14 3	13 0
Topside half-breadth……	…	…	…	16 0	15 8	15 0	14 0	13 3	12 0
Rising half-breadth.									
Length of the lower breadth sweep……	15 6	15 0	13 0	10 5	8 10	7 5	6 8	6 5	6 0
upper breadth sweep……	14 9	14 9	14 9	14 9	14 9	14 9	14 9	14 9	14 9
floor sweep above rising.									
Length on the first diagonal line……	11 1	10 6	9 3	8 2	6 9	5 8	4 0	2 9	0 10
second diagonal line……	15 11	14 10	13 3	11 7	9 10	7 11	5 11	3 11	1 0
third diagonal line……	19 5	18 5	17 0	15 6	13 10	11 6	9 3	6 5	2 7
fourth diagonal line……	21 9	21 3	20 5	19 5	17 10	15 10	13 3	10 2	5 6
fifth diagonal line……	23 9	23 9	…	…	…	…	…	16 5	12 2

BODIES OF THE SHIP OF 50 GUNS AND 1044 $\frac{73}{94}$ TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers	⊕	B	F	K	O	Q	S	V
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
Station from the foremost perpendicular	67 2½	55 6	44 4½	33 3	22 1½	16 6¾	11 0	5 5¼
Lower height of breadth	15 0	15 0½	15 5¼	16 9	18 11½	20 3	21 8½	23 3
Upper height of breadth	19 0	19 0½	19 1½	19 5½	20 3	21 0	22 0½	23 4½
Height of the top-timber line	32 0	32 0	32 0	32 3½	32 9	33 1	33 4½	33 9½
topside line	...	...	...	34 1½	34 7	34 11	35 2½	35 7½
cutting down line	1 8½	1 8½	1 8½	1 11½	2 10½	3 10½	5 7	8 11
rising line *	11 6	0 3½	4 4½	15 6				
Main half-breadth	19 11	19 10	19 9	19 4½	17 11	16 5½	14 2	10 4½
Top-timber half-breadth	16 4	16 2	15 11	15 5½	14 7½	14 1½	13 4½	12 5
Topside half-breadth	...	...	...	15 2½	14 4½	13 11½	13 4½	12 5
Rising half-breadth	6 0	5 11½	3 10½					
Length of the lower breadth sweep	12 2	12 2	12 0	12 0½	11 1	10 6	10 3	10 7
upper breadth sweep	12 0	12 0	12 0	12 0	12 0	12 0	12 0	12 0
floor sweep above the rising	See rising line.							
Length on the first diagonal line	5 2	5 2	4 11½	4 6	3 7	2 8½	2 0	
second diagonal line	10 5½	10 5½	10 0½	9 0	7 1¼	5 9	3 10¾	1 3¾
third diagonal line	15 1	15 1	14 6	13 1	10 7½	8 11	6 9	3 9½
fourth diagonal line	19 11½	19 11½	19 5	18 0	15 3	13 4	10 10½	7 6
fifth diagonal line	24 3	24 3	23 9½	22 6	19 9	17 7¾	15 0	11 3

IN THE FORE AND AFTER BODIES.

Names of the Diagonals	1st	2d	3d	4th	5th
Height up the middle line	3 11½	8 3	12 5½	18 4	24 2
Distance from the middle line on the base line or upper edge of rabbet	4 0	8 3½	12 6½	17 0	
Height up the side line	...	...	...	...	1 6

IN THE AFTER BODY.

Numbers of the Timbers	1	5	9	13	17	21	23	25
Station from the after perpendicular	72 7¼	61 6¼	50 4¾	39 3¼	28 1¾	17 0¼	11 5½	5 10¾
Lower height of breadth	15 0	15 5½	16 5¼	17 9	19 4	21 3½	22 5	23 8
Upper height of breadth	19 0	19 2	19 4½	19 9½	20 8	21 11½	22 9¼	23 9½
Height of the top-timber line	32 1	32 5¼	32 10	33 7	34 4½	35 4¾	35 11½	36 7
topside line	...	35 1	35 7	37 3	38 0¾	40 5½	41 0½	41 8½
cutting down line	1 8½	1 8½	1 10½	2 6	3 9½	5 11	7 4½	9 3½
rising line *	0 5	3 2½	9 9					
Main half-breadth	19 11	19 9	19 5	18 10	18 0	16 5	15 4	14 1
Top-timber half-breadth	16 4	16 3½	16 0	15 6½	14 10	13 9	13 1	12 4
Topside half-breadth	...	16 0	15 8	15 1½	14 5	13 2	12 6	11 9
Rising half-breadth	5 9	4 1½	0 3	Outside.				
Length of the lower breadth sweep	12 2	11 5	10 8½	9 10½	8 9	7 3	6 0	4 6
upper breadth sweep	12 0	12 0	12 0	12 0	12 0	12 0	12 0	12 0
floor sweep above the rising	See rising line.							
Length on the first diagonal line	5 1	4 10	4 4½	3 8	2 9	1 7½	1 1	0 8
second diagonal line	10 4½	9 11	9 1	7 7½	5 8¾	3 5	2 2¾	1 1½
third diagonal line	14 11	14 4	13 3	11 5½	9 0	5 10½	4 1	2 2
fourth diagonal line	19 9¾	19 2½	18 2	16 3½	13 7¼	10 1½	7 11	5 2
fifth diagonal line	24 2	23 6½	22 6	20 10	18 4	14 10	12 7½	9 9¼

* Rising height is 11 feet 6 inches at dead flat; above which, all the other rising heights must be set off.

BODIES OF THE 40-GUN FRIGATE, CARRYING 44 GUNS AND 1189 TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers…….	⊕	D	H	M	Q	U	X	Z	&	& 1
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
Station from the foremost perpendicular……..	70 6	60 2	49 10	39 6	29 2	18 10	13 8	8 6	5 11	3 4
Lower height of breadth……………………	17 6	17 6¼	17 7½	18 1¼	19 0	20 6¼	21 6½	22 10½	23 8½	24 8
Upper height of breadth……………………	18 11	18 11	18 11½	19 3½	20 0	21 3½	22 3	23 5	24 2	24 11½
Height of the top-timber line ……………….	28 0	28 0¾	28 2	28 3	28 7	29 3	29 8½	30 3½	30 8	31 0½
topside line……………………	…	…	…	30 3	30 7	31 3	31 8½	32 4	32 8	33 1
cutting down line…………….	1 10	1 10	1 10	1 11	2 6¼	3 11	5 1	6 7		
rising line……………………	12 0									
Main half-breadth …………………………	20 0	19 11½	19 9½	19 4	18 6	17 0½	15 10	13 9	12 3	10 0
Top-timber half-breadth…………………….	18 6	18 5½	18 3½	17 10	17 0	15 9½	14 10	13 5½	12 6	10 10½
Topside half-breadth……………………….	…	…	…	17 8½	16 10	15 9	14 8½	13 7½	12 11	12 0
Rising half-breadth ………………………..	5 5									
Lengths of the lower breadth sweep…………	15 0	14 11½	14 11	14 6	14 9	15 3	15 4	15 5	15 2	15 0
upper breadth sweep………..	14 0	14 0	14 0	14 0	14 0	14 0	14 0	14 0	14 0	14 0
floor sweep above rising.										
Length on the first diagonal line…………….	8 9	8 7	8 0½	7 7	6 8	5 1½	3 11	2 3	1 0	
second diagonal line………….	13 8½	13 5½	12 10½	12 1½	10 11	8 9	7 4	5 3½	3 11	1 11
third diagonal line …………	17 5	17 3	16 9	16 0½	14 8½	12 5½	10 10	8 6	6 11½	4 10
fourth diagonal line…………	20 5½	20 4	19 11	19 3½	18 0	15 9½	14 2½	11 9	10 2	7 9½
fifth diagonal line……………	22 11	22 10½	22 6	21 11½	20 8	18 8	17 0½	14 7	12 10	10 4¼
sixth diagonal line……………	25 0½	25 0½	24 8¼	24 1½	22 11	20 11	19 3	16 9½	14 11	12 3½

IN THE FORE AND AFTER BODIES.

Names of the Diagonals……………………………	1st	2d	3d	4th	5th	6th
Height up the middle line……………………	6 8	10 11	15 2½	19 6	23 8½	28 0
Distance from the middle line on the base line or upper edge of rabbet……………………	7 5½	12 3	17 1			
Height up the side line………………………	…	…	…	1 8	5 11	10 2

IN THE AFTER BODY.

Numbers of the Timbers ……………………	7	11	15	19	23	27	29	31	32	33
Station from the after perpendicular…………	69 4	59 0	48 8	38 4	28 0	17 8	12 6	7 4	4 9	2 2
Lower height of breadth ……………………	17 10¼	18 4	18 11¼	19 8¼	20 6½	21 8½	22 5	23 2	23 7	24 0
Upper height of breadth……………………	19 1¾	19 5½	20 0	20 8	21 5	22 4½	22 11	23 7	23 11	24 3½
Height of the top-timber line………………	28 2½	28 4½	28 8	29 1	29 8	30 5½	30 10	31 4½	31 7½	31 10½
topside line……………………	…	30 5½	30 8½	31 1½	31 8½	32 6	33 0	33 6	33 9	34 0
cutting down line…………….	1 10	1 10½	2 2	2 9¼	3 10½	5 8	7 0	9 0	10 5	
rising line.										
Main half-breadth……………………………	19 10	19 8½	19 5½	19 1	18 5½	17 6	16 9½	16 0	15 7	15 1
Top-timber half-breadth……………………	18 5	18 3	17 10½	17 7	17 0	16 1	15 6	14 9	14 4½	13 11
Topside half-breadth ………………………	…	18 1	17 9	17 4½	16 9½	15 10½	15 3½	14 7¾	14 3	13 9½
Rising half-breadth.										
Length of the lower breadth sweep …………	14 3	13 3	12 2	11 3	9 11	8 7	7 7½	6 7	5 11	5 0
upper breadth sweep…………	14 0	14 0	14 0	14 0	14 0	14 0	14 0	14 0	14 0	14 0
floor sweep above the rising.										
Length on the first diagonal line…………….	8 4	7 8½	6 10¼	5 9¼	4 9½	3 9	3 2	2 4	1 7¾	0 11¼
second diagonal line…………	13 3½	12 7¼	11 6	9 11	8 2¾	6 5¼	5 6½	4 2	3 1¾	1 9¾
third diagonal line…………	17 0½	16 5½	15 4	13 9½	11 9	9 5¾	8 2¾	6 5½	5 2	3 0¾
fourth diagonal line ……… …	20 0½	19 6	18 6½	17 1	15 2	12 8½	11 3	9 3	7 9¾	5 3
fifth diagonal line…………….	22 6¾	22 0½	21 3	20 0	18 3½	16 1¼	14 6	12 6¾	11 1½	8 11
sixth diagonal line……………	24 8¾	24 2½	23 7	22 7¾	21 3	19 4	17 11½	16 4½	15 2½	13 6

BODIES OF THE FRIGATE OF 38 GUNS AND 943 TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers......	⊕		C		G		L		P		T		W		Y	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
Station from the foremost perpendicular	64	0	52	6½	42	11	33	3½	23	8	14	0½	9	2¾	4	5
Lower height of breadth..........................	17	3	17	3	17	6	18	0	19	2	20	11	22	1	23	8
Upper height of breadth	19	2	19	2	19	2	19	5	20	0	21	4	22	2	23	8
Height of the top-timber line....................	27	5	27	6	27	7	27	10	28	1	28	4	29	0	29	4
topside line	...		...		...		30	6	30	9	31	0	31	8	22	0
cutting down line................	1	11	2	0	2	1	2	4½	3	0	4	6	6	0	8	5
rising line..........................	1	0	1	0	1	5	2	4½	3	10						
Main half-breadth	19	2	19	2	19	1	18	9	17	7	15	3	13	0	9	2
Top-timber half-breadth	16	10	16	10	16	10	16	7	15	10	14	4	12	11	9	11
Topside half-breadth	...		...		...		16	5	15	8	14	2	13	0	10	5
Rising half-breadth................................	5	1	5	0	4	6	3	4	2	7						
Length of the lower breadth sweep.............	13	3	13	0	12	6	11	10	10	9	10	6	11	0	11	0
upper breadth sweep............	12	0	12	0	12	0	12	0	12	0	12	0	12	0	12	0
floor sweep above the rising.....	10	10	10	10	10	10	10	10	10	10						
Length on the first diagonal line.................	9	11	9	10	9	7	8	9	7	7	5	7	4	4	1	10
second diagonal line.............	15	4	15	3	14	8	16	9	11	5	8	9	6	8	3	10
third diagonal line................	18	6	18	5	17	11	16	8	14	10	11	8	9	2	5	10
fourth diagonal line	20	0	...		...		...		...		...		11	9	7	11

IN THE FORE AND AFTER BODIES.

Names of the Diagonals..................................	1st		2d		3d		4th		5th	
Height up the middle line........................	9	6	13	11	17	9	20	8	22	11
Distance from the middle line on the base line or upper edge of rabbet	5	9	11	5						
Height up the side line	...		...		0	10½	9	6	15	6

IN THE AFTER BODY.

Numbers of the Timbers........................	1		5		9		13		17		21		25		27		29	
Station from the after perpendicular............	70	3½	60	8	51	0½	41	5	31	9½	22	2	12	6½	7	8¾	2	11
Lower height of breadth	17	5	17	6	17	9½	18	4	19	2	20	6	22	3	23	4	24	4½
Upper height of breadth..........................	19	2	19	2	19	4	19	7	20	0	20	11	22	3	23	4	24	4½
Height of the top-timber line....................	27	5	27	9	28	2	28	6	29	0	29	7	30	6	30	10	31	4
topside line........................	...		30	6	30	11	31	3	31	9	32	4	33	3	33	7	34	1
cutting down line................	1	11	2	0	2	2	2	4	2	9	4	0	7	2	9	8		
rising line	1	0	1	1½	1	6	2	3	3	7	6	4						
Main half-breadth..................................	19	2	19	1½	19	0	18	8	18	0	17	0	15	5	14	3½	13	2
Top-timber half-breadth..........................	16	10	16	8	16	5½	16	2	15	8	14	11	13	8	13	0	12	3
Topside half-breadth...............................	...		16	2	16	0	15	9	15	2	14	5	13	3	12	6	11	10
Rising half-breadth.................................	5	1	5	0	4	11	4	5	3	2	0	7						
Length of the lower breadth sweep	13	2	13	0	12	0½	10	0	8	11	7	8	6	2	5	5	3	10
upper breadth sweep............	12	0	12	0	12	0	12	0	12	0	12	0	12	0	12	0	12	0
floor sweep above the rising......	10	10	10	10	10	10	10	10	10	10	10	0						
Length on the first diagonal line................	9	11	9	10	9	6	9	0	8	1	6	5	3	10	2	8	1	3
second diagonal line............	15	4	15	3	14	10	13	10	12	3	9	5	6	1	4	2½	2	0½
third diagonal line................	18	6	18	5	18	0	17	1	15	4	12	4	8	8	6	2	3	3
fourth diagonal line.............	20	0	19	11	19	6	18	9	17	3	15	1	11	5	8	10	5	3
fifth diagonal line	...		...		...		...		...		...		14	5	12	3½	9	1½

BODIES OF THE FRIGATE OF 36 GUNS AND 877 TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers	⊕	C	G	L	P	T	W	X
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
Station from the foremost perpendicular	61 7	49 7	39 11	30 3	20 7	10 11½	6 1½	3 8½
Lower height of breadth	17 3	17 4¼	17 9¼	18 6½	19 11	22 1½	23 8	24 7
Upper height of breadth	18 11	18 11½	19 1	19 6½	20 7½	22 6	23 11¼	24 9½
Height of the top-timber line	27 0	27 0	27 0½	27 3½	27 7	28 0½	28 4½	28 7½
topside line	...	...	...	29 1¼	29 5½	29 10½	30 3	30 6
cutting down line	1 8	1 8	1 8	2 0½	3 0½	5 0½	6 8	
rising line *	12 0	1 0	4 9½	13 10				
Main half-breadth	18 10	18 10	18 10	18 5½	17 1½	13 9	10 7½	8 3
Top-timber half-breadth	16 9	16 9	16 9	16 6	15 9½	13 7	11 1	9 1
Topside half-breadth	...	...	...	16 2½	15 8	13 9½	11 7½	9 10
Rising half-breadth	4 3½	3 7	0 9					
Length of the lower breadth sweep	14 2	13 8	13 1	12 8	12 9	13 5	14 0	14 0
upper breadth sweep	11 3	11 3	11 3	11 3	11 3	11 3	11 3	11 3
floor sweep above the rising	See rising line.							
Length on the first diagonal line	9 4	9 3	8 10	7 11¼	6 6½	4 2	2 1	0 8
second diagonal line	13 11½	13 9	13 1	11 10½	9 10½	6 9½	4 4½	2 8½
third diagonal line	17 0	16 10	16 2¼	14 11½	12 10¾	9 4½	6 6½	4 7
fourth diagonal line	19 4	19 1½	18 8	17 7½	15 7½	11 9½	8 8	6 5½
fifth diagonal line	20 10½	20 9	20 5	19 6	17 7½	13 8½	10 4	7 11

IN THE FORE AND AFTER BODIES.

Names of the Diagonals	1st	2d	3d	4th	5th	6th
Height up the middle line	8 0	12 0	15 8	19 2½	22 2	28 0
Distance from the middle line on the base line or upper edge of rabbet	7 4	13 2	18 1			
Height up the side line	...	...	...	3 8½	7 10½	11 8

IN THE AFTER BODY.

Numbers of the Timbers	7	11	15	19	23	25	27	29	30
Station from the after perpendicular	58 5	48 9	39 1	29 5	19 9	14 11	10 1	5 3	2 10
Lower height of breadth	17 5½	17 9½	18 5	19 3	20 4	20 11½	21 8½	22 9	22 11
Upper height of breadth	18 10½	19 1	19 5½	20 1½	20 11	21 6	22 1	22 6	23 1½
Height of the top-timber line	27 4	27 8	28 1	28 8	29 4	29 8½	30 2	30 6¾	30 9¾
topside line	29 1½	30 0½	30 6	31 1	31 9½	32 1¾	32 7	33 0	33 4
cutting down line	1 8	1 10	2 4½	3 6	5 4½	6 10½	8 9	11 0	
rising line *	2 2½	7 10	18 0						
Main half-breadth	18 9	18 6½	18 1½	17 5	16 5	15 9	15 0	14 0	13 7
Top-timber half-breadth	16 8½	16 6½	16 1	15 5	14 6	13 11	13 3½	12 7	12 2½
Topside half-breadth	...	16 3	15 8½	15 0	14 1	13 6¾	12 11	12 2½	11 10½
Rising half-breadth	2 7¼	1 8	Outside.						
Length of the lower breadth sweep	12 7	12 0	10 6	9 1½	7 7	6 9	5 9½	4 6	3 9
upper breadth sweep	11 3	11 3	11 3	11 3	11 3	11 3	11 3	11 3	11 3
floor sweep above the rising	See rising line.								
Length on the first diagonal line	8 10	8 3	7 1	5 6½	3 9	2 10	1 11½	1 1½	0 8
second diagonal line	13 4	12 5	10 10	8 9½	6 4	5 0	3 6½	2 0	1 2
third diagonal line	16 4¼	15 5½	13 10½	11 10½	9 2	7 7½	5 9½	3 8	2 3
fourth diagonal line	18 10¾	18 8	16 8	14 9½	12 3	10 8	8 9½	6 3½	4 6
fifth diagonal line	20 8	19 11	18 9	17 2½	14 11	13 5½	11 8	9 2½	7 4½
sixth diagonal line	...	...	...	...	19 2	18 0	16 7¼	14 9½	13 5½

* Rising height is 12 feet at dead flat; above which, all the other rising heights must be set off.

BODIES OF THE FRIGATE OF 32 GUNS AND 710 TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers......	⊕	B	F	K	O	S	U	X
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
Station from the foremost perpendicular........	58 4	51 11½	42 8½	33 5½	24 2½	14 11½	10 4	5 8½
Lower height of breadth........................	16 1	16 1	16 3½	16 10	17 10	19 6½	20 8	22 0
Upper height of breadth........................	17 9	17 9	17 9	18 0	18 10	20 3	21 1	22 4
Height of the top-timber line..................	25 8	25 8	25 9	25 10½	26 3	26 8	27 0	27 4
topside line	...	...	...	27 10½	28 3	28 8	29 0	29 4
cutting down line	1 6	1 6	1 6	1 9	2 5	3 10	5 1	6 11
rising line.........................	...	0 3½	2 3	7 7	19 11			
Main half-breadth..................................	17 5	17 5	17 5	17 4	16 7½	14 7	12 8	9 6
Top-timber half-breadth..........................	15 6	15 6	15 6	15 3½	14 11	13 11	12 9	10 8
Topside half-breadth..............................	...	...	...	15 0	14 8	14 0	13 3	11 7
Rising half-breadth	4 3	4 1	2 10½	1 3 Outside	12 0 Outside			
Length of the lower breadth sweep	15 1	15 0	14 6½	12 10	11 4	10 9	10 8	10 11
Length on the first diagonal line	7 5	7 5	7 5	7 2	6 6½	5 0	3 10	1 10
second diagonal line............	10 10	10 10	10 7	9 11½	8 8	6 7	5 1	2 11
third diagonal line...............	13 8	13 8	13 4	12 6	10 10	8 5	6 8	4 2
fourth diagonal line.............	16 11	16 11	16 8	15 10	14 2	11 6	9 4½	6 6
fifth diagonal line................	19 5	19 5	19 3	18 8	17 4	14 7	12 4½	9 0

IN THE FORE AND AFTER BODIES.

Names of the Diagonals......................	1st	2d	3d	4th	5th		1st	2d	3d	4th	5th
Height up the middle line	7 5	9 9	12 2	16 1	20 8	After Body.	5 10	9 3	12 8	18 5½	22 10
Distance from the middle line on the base line or upper edge of the rabbet	3 11	8 0	12 5	...	...		4 7	8 7	13 1		
Height up the side line	...	...	...	2 0	9 0		...	...	...	4 8	10 8

IN THE AFTER BODY.

Numbers of the Timbers	1	5	9	13	17	21	25	27	29
Station from the after perpendicular............	68 11	59 8	50 5	41 2	31 11	22 8	13 5	8 9½	4 2
Lower height of breadth........................	16 1	16 2	16 5	17 0	17 9	18 9	19 10½	20 8	21 6
Upper height of breadth........................	17 9	17 9	17 10	18 1	18 9	19 6	20 6	21 1	21 10
Height of the top-timber line..................	25 8	25 10	26 1	26 6	27 0	27 6	28 1½	28 6	28 11
topside line........................	...	...	28 10	29 3	29 9	30 3	30 10½	31 3	31 8
cutting down line	1 6	1 7	1 8	2 2	3 0	4 5	6 11	8 7	11 9
rising line	...	1 2	4 10	14 6					
Main half-breadth..................................	17 5	17 5	17 3	16 9	16 3	15 5½	14 3½	13 8	12 10½
Top-timber half-breadth..........................	15 6	15 5	15 3	14 10	14 4	13 8	12 9	12 3	11 8
Topside half-breadth	...	...	14 10	14 6	13 11	13 3	12 4	11 10	11 4
Rising half-breadth................................	4 3	3 7	1 0	6 8 Outside					
Length of the lower breadth sweep.............	15 1	13 10	12 1	10 7	8 11½	7 7	6 1	5 4	4 1
Length on the first diagonal line..................	6 4	6 2	5 10	5 3	4 4	3 0	1 11	1 3	0 8
second diagonal line............	10 7	10 4	9 7	8 7	7 0	5 3	3 1½	2 1	1 1
third diagonal line...............	14 0	13 9	12 11	11 8	9 11	7 8½	5 0	3 7½	2 11
fourth diagonal line............	18 4	18 0	17 4	16 2	14 9	12 8	9 10½	8 0	5 3
fifth diagonal line................	...	...	...	...	...	...	14 0	12 7	10 3

BODIES OF THE FRIGATE OF 28 GUNS AND 594 TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers	⊕		D		H		M		Q		U		X	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
Station from the foremost perpendicular	54	6	45	6	36	6	27	6	18	6	9	6	5	0
Lower height of breadth	12	10	12	11	13	3	14	3	16	1	18	4	19	7½
Upper height of breadth	15	9	15	9	15	9½	16	2½	17	1	18	7	19	8
Height of the top-timber line	24	1	24	3	24	6	25	0	25	7½	24	5	26	10
topside line	...		...		...		27	5	28	0½	28	10	29	3
cutting down line	1	8	1	8	1	9	1	11	2	6	4	6	6	7
rising line	...		0	7	4	10	14	0						
Main half-breadth	16	6	16	6	16	4	16	0	14	9½	11	10	8	11
Top-timber half-breadth	14	5	14	5	14	3	14	0	13	6	11	6	9	3
Topside half-breadth	...		...		...		13	11	13	6	11	8	9	6
Rising half-breadth	4	3	4	0½	1	6½	5	7						
							Outside							
Length of the lower breadth sweep	9	2	8	11	8	4	7	9	8	2	9	4	9	9
Length on the first diagonal line	8	0	7	11	7	8	7	0	5	11	3	10	2	0
second diagonal line	11	10	11	8	11	2	10	2	8	4	5	7	3	5
third diagonal line	14	10½	14	9	14	4	13	2	11	1	7	10	5	4
fourth diagonal line	17	2	17	1	16	8	15	6	13	6	9	10½	7	2
fifth diagonal line	...		...		...		...		15	5	11	10	8	9½

IN THE FORE AND AFTER BODIES.

Names of the Diagonals	1st		2d		3d		4th		5th	
Height up the middle line	7	2	10	1	13	7	16	5	19	3
Distance from the middle line on the base line or upper edge of rabbet	5	10	10	1	15	11				
Height up the side line	...		...		...		5	1	10	0

IN THE AFTER BODY.

Numbers of the Timbers	3		7		11		15		19		23		27		29	
Station from the after perpendicular	60	6	51	6	42	6	33	6	24	6	15	6	6	6	2	0
Lower height of breadth	12	10	13	4	14	0	14	11	16	1	17	8	19	4	20	4
Upper height of breadth	15	9	15	9	16	0	16	7	17	4	18	5	19	9	20	7
Height of the top-timber line	24	1	24	4	24	6	24	11	25	6	26	1½	27	0	27	7
topside line	...		27	8	27	10	28	3	28	10	29	5½	30	4	30	11
cutting down line	1	8	1	9	1	11	2	4	3	2	5	0	8	1		
rising line	0	5	2	5	6	11	14	10								
Main half-breadth	16	6	16	6	16	3	15	9	14	11	13	9	12	3	11	5
Top-timber half-breadth	14	5	14	4	14	0	13	6	12	11	12	0	10	11	10	4
Topside half-breadth	...		13	6	13	3	12	11	12	4	11	8	10	10	10	2
Rising half-breadth	4	1	2	9	0	9	7	0								
					Outside		Outside									
Length of the lower breadth sweep	8	9	8	2	7	8	7	3	6	7	5	8	4	2	3	3
Length on the first diagonal line	8	0	7	10	7	3	6	4	4	11	3	6	1	11	1	0
second diagonal line	11	8	11	4	10	5	9	1	7	2	5	2	2	9	1	5
third diagonal line	14	8½	14	4	13	6	12	1	10	1	7	8	4	5	2	6
fourth diagonal line	17	0	16	8	15	11	14	8½	12	10	10	3	6	6½	4	0
fifth diagonal line	...		...		...		...		...		13	0	9	7	6	10

BODIES OF THE FRIGATE OF 24 GUNS AND 513 TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers......	⊕	(B)	D	H	M	Q	S	T
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
Station from the foremost perpendicular........	52 3	47 9	38 9	29 9	20 9	11 9	7 3	5 0
Lower height of breadth........................	12 5	12 5	12 6	13 3	14 7	16 10	18 1	18 9
Upper height of breadth........................	15 2	15 2	15 2	15 5	16 0	17 4	18 3	18 10
Height of the top-timber line..................	23 0	23 0	23 2	23 5	23 10	24 4	24 8	24 10
topside line........................	...	...	...	25 3	25 8	26 2	26 6	25 6
cutting down line................	1 5	1 5	1 5	1 7	2 0	3 4	4 11	6 1
rising line *......................	...	...	2 0	7 10				
Main half-breadth..............................	15 9	15 9	15 8	15 6	14 9	11 6	10 2	8 6
Top-timber half-breadth........................	13 10	13 10	13 10	13 8	13 2	11 5	10 2	9 0
Topside half-breadth...........................	...	...	...	13 1	12 9	11 8½	10 6	9 6
Rising half-breadth............................	4 2	4 2	3 3½	1 0 Outside				
Length of the lower breadth sweep.............	8 11	8 9	8 4	7 0	6 10	8 7	9 7	9 10
upper breadth sweep............	9 10	9 10	9 10	9 10	9 10	9 10	9 10	9 10
Length on the first diagonal line................	8 6	8 6	8 4	8 0	6 10	4 10½	3 4	2 3
second diagonal line............	11 8	11 8	11 6	10 8	9 1	6 6	4 9	3 5½
third diagonal line..............	14 3	14 3	14 1	13 3½	11 5	8 7	6 7	5 3
fourth diagonal line..............	16 3	16 3	16 2	15 5	13 7	10 8½	8 5½	6 10
fifth diagonal line................	...	...	...	...	...	12 8	10 2	8 6

IN THE FORE AND AFTER BODIES.

Names of the Diagonals....................................	1st	2d	3d	4th	5th
Height up the middle line............................	7 6	10 0	12 9	15 6	18 4
Distance from the middle line on the base line or upper edge of the rabbet....................	5 10	10 0	14 10		
Height up the side line..............................	...	...	...	4 5	8 8

IN THE AFTER BODY.

Numbers of the Timbers............................	3	7	11	15	19	23	25
Station from the after perpendicular...........	52 0	43 0	34 0	25 0	16 0	7 0	2 6
Lower height of breadth........................	12 9	13 5	14 5	15 6	17 0	18 7	19 6
Upper height of breadth........................	15 3	15 7	16 0	16 8	17 6	18 9	19 7
Height of the top-timber line..................	23 2	23 5½	23 10	24 6	25 3	26 0	26 5
topside line........................	...	25 11½	26 10	27 6	28 3	29 0	29 5
cutting down line................	1 6	1 8	2 1	2 10½	4 8	8 0	
rising line*........................	1 5	5 6	13 6				
Main half-breadth..............................	15 7½	15 6	15 0	14 6	13 3	11 9½	10 10
Top-timber half-breadth........................	13 8	13 5	13 0	12 5	11 7½	10 6	9 11
Topside half-breadth...........................	...	13 0	12 5	11 10	11 2	10 2	9 8
Rising half-breadth............................	3 3	0 6	5 4 Outside				
Length of the lower breadth sweep.............	8 10	7 1	6 5	5 10	5 0	3 9	2 10
upper breadth sweep............	9 10	9 10	9 10	9 10	9 10	9 10	9 10
Length on the first diagonal line................	7 2	6 7	5 8	4 4	2 10	1 4	0 8
second diagonal line............	11 4	10 7	9 4	7 5	5 3	2 8	1 3
third diagonal line..............	13 10	13 1½	11 9½	9 10	7 4	4 0	2 0
fourth diagonal line..............	15 9	15 2	14 1	12 2	9 10	6 0	3 4
fifth diagonal line................	17 4	16 9	15 10	14 5	12 2	8 10	5 8

* Rising height is 10 feet at dead-flat, above which all the other rising heights must be set off.

BODIES OF THE SLOOP OF 18 GUNS AND $392\frac{4}{94}$ TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers......	⊕		D		H		M		O		Q		R	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
Station from the foremost perpendicular........	43	9	34	6	25	2	15	11	11	3	6	5	4	1
Lower height of breadth..........................	12	4	12	6	12	11¼	13	9	14	4	15	0	15	6¼
Upper height of breadth	13	9	13	10	14	2	14	8½	15	1¼	15	7¾	15	11¼
Height of the top-timber line....................	21	0	21	0½	21	1½	21	4	21	5½	21	8¼	21	10¼
topside line..........................	...		...		22	4½	22	7	22	8½	22	11¼	23	1¼
cutting down line	1	5	1	6	1	9½	2	8	3	6	4	10½	6	0
rising line *........................	*Well*		0	10¾	3	11¼	11	6½						
Main half-breadth....................................	14	0	13	10½	13	6¾	12	7¼	11	7½	9	6¾	7	8¾
Top-timber half-breadth.........................	13	3	13	1	12	10	12	1¾	11	5	9	11¾	8	7
Topside half-breadth..............................	...		...		12	10	12	3	11	6	10	2	9	2
Rising half-breadth................................	3	9	3	2	0	11								
Length of the lower breadth sweep	11	6	11	2½	10	2½	8	4¾	7	7	6	8½	6	5
upper breadth sweep	11	0	11	0	11	0	11	0	11	0	11	0	11	0
Length on the first diagonal line.................	6	0	5	9	5	0½	4	0	3	1½	1	8	0	7¾
second diagonal line.............	9	2¼	8	10½	7	10½	6	3½	4	11¾	3	3½	2	0
third diagonal line...............	11	11	11	6½	10	6¾	8	8¾	7	2	5	2½	3	9
fourth diagonal line..............	14	0	13	8¾	12	10¼	11	1	9	6	7	4¼	5	9½
fifth diagonal line.................	15	3½	15	0½	14	4½	12	9¼	11	5	9	2	7	5½
sixth diagonal line...............	16	0	15	9	15	3	13	11½	12	8½	10	5½	8	6½

IN THE FORE AND AFTER BODIES.

Names of the Diagonals..............................	1st		2d		3d		4th		5th		6th	
Height up the middle line.................	4	10½	7	6¾	10	5	13	2½	15	5	17	6½
Distance from the middle line on the base line or upper edge of rabbet.....	5	4½	8	4	12	6½						
Height up the side-line....................	...		...		...		2	5½	5	10	8	11½

IN THE AFTER BODY.

Numbers of the Timbers..............................	6		10		14		18		20		22		24		26	
Station from the after perpendicular............	49	5	40	0	30	8	21	4	16	8	12	1	7	5	2	9
Lower height of breadth	12	6¼	12	10	13	6	14	5¾	15	1	15	9¾	16	7½	17	6
Upper height of breadth	13	10	14	1	14	7	15	4	15	9¾	16	5½	17	1	17	9
Height of the top-timber line.....................	21	1½	21	4½	21	9	22	2	22	5½	22	9	23	0½	23	4
topside line........................	22	4½	22	7½	23	0	23	5	23	8½	24	0	24	3½	24	7
cutting down line	1	6¼	1	10½	2	6¾	3	10¼	4	10	6	0½	7	8½		
rising line *	2	6½	9	6												
Main half-breadth....................................	13	11¼	13	8¼	13	2	12	3½	11	8½	11	0¼	10	2	9	3½
Top-timber half-breadth..........................	13	1½	12	9½	12	3½	11	5½	10	8¼	10	3½	9	6	8	7¼
Topside half-breadth................................	13	1½	12	9½	12	3½	11	5½	10	10	10	1¾	9	3½	8	4
Rising half-breadth	2	4	1	9	Outside											
Length of the lower breadth sweep............	10	10	9	10¾	8	10	7	6	6	9	5	10	4	7¼	3	2
upper breadth sweep...........	11	0	11	0	11	0	11	0	11	0	11	0	11	0	11	0
Length on the first diagonal line................	5	9	5	0½	4	0½	2	11½	2	4½	1	9½	1	0¼	0	5½
second diagonal line.............	8	9	7	9½	6	3¾	4	10	4	0	3	1¼	1	10½	0	9½
third diagonal line...............	11	6	10	7	8	11	7	1	6	1½	4	11¾	3	5¼	1	5¾
fourth diagonal line..............	13	8	12	11	11	7¼	9	6½	8	5½	7	2	5	6	2	10
fifth diagonal line................	15	0	14	5½	13	5½	11	8	10	6	9	1¼	7	4¼	4	7
sixth diagonal line...............	15	9¼	15	4½	14	6¾	13	2	12	2¾	11	0¾	9	4½	6	10½

* Rising height is 8 feet 10½ inches at dead-flat, above which all the other rising heights must be set off.

BODIES OF THE DENMARK YACHT OF 10 GUNS AND 218 TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers......	⊕	B	D	F	H	K	M	O
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
Station from the foremost perpendicular........	34 4	30 5	26 1	21 9	17 5	13 1	8 9	4 5
Lower height of breadth..........................	9 11½	9 11¾	10 0¾	10 2¾	10 6	10 11	11 5	12 1½
Height of the top-timber line.....................	14 4¾	14 5	14 5½	14 6⅝	14 8½	14 11	15 2½	15 6½
topside line.........................	...	...	...	...	16 0¾	16 3¼	16 6¾	16 10½
cutting down line.................	1 6	1 6	1 6½	1 7	1 8	1 11¼	2 8¼	5½
Main half-breadth..................................	11 6	11 5¾	11 4¼	11 3	10 10	9 11¾	8 4¾	5 7½
Top-timber half-breadth..........................	10 7	0 6⅞	10 6½	10 4¼	10 0¾	9 5½	8 4¾	6 1½
Topside half-breadth..............................	...	...	...	...	...	9 6	8 7½	6 10
Length of the lower breadth sweep.............	8 4¼	8 3¾	8 2¼	8 0	7 7¼	6 10¾	5 10½	6 1
upper breadth sweep............	8 4	*All*						
Length on the first diagonal line................	5 1½	5 1	5 0¼	4 11	4 8½	4 4	3 4¾	1 8½
second diagonal line............	6 9¼	6 8¾	6 7	6 4	5 11	5 2½	4 1½	2 2
third diagonal line...............	8 7½	8 6½	8 4¾	8 0¼	7 5¼	6 6½	5 2	2 9¾
fourth diagonal line.............	10 3½	10 2½	10 0½	9 9	9 2	8 0¾	6 5¼	3 9½
fifth diagonal line................	11 3	11 2½	11 1	10 10½	10 4	9 3½	7 6	4 8¼

IN THE FORE AND AFTER BODIES.

Names of the Diagonals..........................	1st	2d	3d	4th	5th	4th	5th
				Fore Body		*After Body*	
Height up the middle line................	5 6	6 6	7 6¾	8 10½	10 1½	9 10½	11 8½
Distance from the middle line on the base line or upper edge of the rabbet......	2 11½	6 4¼	10 5½				
Height up the side line....................	...	...	...	2 11	5 8	2 8	5 6¼

IN THE AFTER BODY.

Numbers of the Timbers..........................	2	6	10	14	16	18	20	22	*Tuck*
Station from the after perpendicular...........	46 10	38 2	29 6	20 10	16 6	12 2	7 10	3 6	
Lower height of breadth..........................	10 0	10 2	10 6	11 0¼	11 4½	11 9¼	12 3	12 9¾	
Height of the top-timber line.....................	14 6	14 8	15 0¼	15 3¼	15 10½	16 2¾	16 7½	17 0¾	
topside line.........................	...	...	16 9½	17 3½	17 7½	17 11½	18 4	18 9¼	
cutting down line.................	1 7½	1 8½	1 9½	2 3½	2 9	3 6	4 8½	6 11½	
Main half-breadth..................................	11 5½	11 4⅛	11 0	10 6	10 2½	9 9	9 3½	8 9	
Top-timber half-breadth..........................	10 6¾	10 5⅝	10 1¾	9 8⅜	9 4½	9 0	8 6½	8 0½	
Topside half-breadth..............................	...	...	9 11½	9 6	9 2	8 9	8 3¾	7 9¼	
Length of the lower breadth sweep.............	8 4¼	8 4¼	7 11¾	6 11½	6 0½	4 11⅛	3 9⅝	2 10	
upper breadth sweep............	8 4	*All*							
Length on the first diagonal line................	5 1	5 0	4 8¼	4 1½	3 7¼	3 0	2 2	1 1½	
second diagonal line............	6 9¼	6 7	6 1	5 2	4 5¾	3 6½	2 5½	1 1	
third diagonal line...............	8 7	8 3¾	7 8¼	6 6½	5 8	4 6	3 1½	1 5	
fourth diagonal line.............	10 9¼	10 6½	10 0	8 9½	7 11	6 8½	5 2	3 0½	0 11
fifth diagonal line................	11 11¼	11 9	11 3½	10 3½	9 7	8 7¼	7 3	5 3½	3 2½

BODIES OF A BOMB VESSEL OF 12 GUNS AND $298\frac{24}{94}$ TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers	⊕		A		E		I		L		N	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
Station from the foremost perpendicular	36	3	28	9	20	9	12	9	8	9	4	9
Lower height of breadth	9	10½	9	11½	10	7	12	2	13	6	15	6
Upper height of breadth	11	7	11	7¼	11	11	13	0	14	2	15	10
Height of the top-timber line	17	7¾	17	10¼	18	3½	18	10	19	3	19	9
topside line	...		...		...		20	0	20	5	20	10½
cutting down line	1	3	1	3¼	1	4	2	1	3	0½	4	7
rising line	0	5	0	6	1	0½	2	3	3	4½	5	4
Main half-breadth	13	6	13	6	13	2½	12	2	11	0	8	7½
Top-timber half-breadth	12	6	12	6	12	2½	11	4½	10	6	8	7½
Topside half-breadth.												
Rising half-breadth	4	4½	4	4	3	10	2	4	0	11		
Length of the lower breadth sweep	10	7	10	4	9	10	9	5	9	10	10	9
upper breadth sweep	12	6	12	6	12	6	12	6	12	6	12	6
floor sweep above the rising	9	0	9	0	9	0	9	0	9	0	9	0
Length on the first diagonal line	6	6½	6	5½	6	0½	4	11	3	8	1	8
second diagonal line	11	5	11	3½	10	7	8	10¼	7	3	4	10
third diagonal line	15	0	14	10½	14	3	12	5	10	7½	7	10½
fourth diagonal line	17	7	17	5¾	16	11	15	3	13	5	10	5

IN THE FORE AND AFTER BODIES.

Names of the Diagonals	1st		2d		3d		4th	
Height up the middle line	4	11	9	3	13	6	17	10½
Distance from the middle line on the base line or upper edge of rabbet	4	11	9	3	13	6		
Height up the side line	...		...		...		4	5

IN THE AFTER BODY.

Numbers of the Timbers	1		5		9		13		17		21		23	
Station from the after perpendicular	47	7	39	7	31	7	23	7	15	7	7	7	3	7
Lower height of breadth	9	11	10	2	10	8	11	6	12	9¼	14	6	15	7
Upper height of breadth	11	7½	11	8½	11	11½	12	6½	13	6	14	10½	15	10
Height of the top-timber line	17	7¾	17	9¾	18	1	18	6¾	19	3	20	1¼	20	7
topside line	...		...		...		...		20	4	21	2½	21	8
cutting down line	1	3¼	1	4	1	8½	2	3½	3	3	4	7¾	5	7
rising line	0	6½	0	11	1	8½	2	11	4	11	7	10	9	10½
Main half-breadth	13	6	13	5	13	1½	12	7	11	6¾	9	5	7	0
Top-timber half-breadth	12	6¼	12	4½	12	0½	11	6	10	6	8	3½	6	4
Topside half-breadth	...		...		...		...		10	3	8	0½	6	1
Rising half-breadth	4	4½	4	3¼	3	9½	2	11½	1	7½				
Length of the lower breadth sweep	10	7	9	10	7	10½	6	8	5	7¾	4	6	3	4¼
upper breadth sweep	12	6	12	6	12	6	12	6	12	6	12	6	12	6
floor sweep above the rising	9	0	9	0	9	0	9	0	9	0	9	0	9	0
Length on the first diagonal line	6	5	6	0	5	2½	4	2	2	11½	1	5½	0	8¼
second diagonal line	11	3½	10	9½	9	10½	8	4	6	4	3	7	1	9
third diagonal line	14	11	14	6¼	13	8¼	12	2½	9	11	6	8	4	1
fourth diagonal line	17	7	17	3¾	16	7	15	4½	13	5	10	2½	7	5¾

BODIES OF A BRIGANTINE OF 10 GUNS, 16 SWIVELS, AND 201 TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers......	⊕	D	H	M	O	P	Q
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
Station from the foremost perpendicular	34 5	26 9	18 9	10 9	6 9	4 9	2 9
Lower height of breadth.........................	11 1	11 2	11 8	13 0	14 1	14 11	15 9
Height of the topside............................	15 3	15 3	15 5	16 0	16 6	16 8½	17 0
cutting down line................	0 11	0 11	1 1½	2 3	3 9	4 10½	
Main half-breadth.......	12 3½	12 3	11 9	10 2	8 4	7 1	5 4½
Topside half-breadth.............................	12 1	11 11	11 6	10 1	8 6	7 4	5 8
Length of the lower breadth sweep.............	8 3	8 3	8 6	8 1			
Aft part of the rabbet of the stem above the upper edge of the keel........................	...	...	...	0 9	3 3	3 7	5 5
Length on the first diagonal line.................	5 7	5 6	5 4	4 3	3 1	2 1	0 9
second diagonal line.............	8 1	8 0	7 7	6 1½	4 8	3 7	2 1
third diagonal line................	11 0	10 8	10 2	8 1½	6 4	5 2	3 4
fourth diagonal line	...	...	...	9 9	7 9	6 3	4 4
fifth diagonal line................	...	...	...	...	8 9	7 3	5 2

IN THE FORE AND AFTER BODIES.

Names of the Diagonals........................	1st	2d	3d	4th	5th
Height up the middle line.................	6 1	8 4	11 0	13 1	15 3½
Distance from the middle line on the base line or upper edge of rabbet.....	4 1	8 0			
Height up the side line	...	...	0 10½	5 1½	8 9

IN THE AFTER BODY.

Numbers of the Timbers.........................	2	6	10	14	16	18	20	*Tuck*
Station from the after perpendicular...........	40 6	32 6	24 6	16 6	12 6	8 6	4 6	
Lower height of breadth.........................	11 2	11 7	12 3	13 0	13 6	14 2	14 9	
Height of the topside............................	15 4	15 8	16 3	17 0½	17 6	18 1	18 7	
cutting down line................	0 11	0 11½	1 7	3 2	4 5	6 0	8 0	
Main half-breadth................................	12 3½	12 3	11 11	11 4	10 10	10 3	9 7	
Topside half-breadth.............................	12 1	11 11	11 7	10 8½	10 3	9 8	9 0	
Length of the lower breadth sweep	7 8	7 2	6 6	5 10½	5 1	4 1½	3 0	
Length on the first diagonal line.................	5 4	5 0	4 4	3 4	2 7½	2 0	0 10½	
second diagonal line............	7 11	7 4	6 4	5 0	3 11	2 11	1 6	
third diagonal line...............	10 9	10 1	9 0	7 4	6 2	4 9½	3 3	1 8½
fourth diagonal line............	...	...	...	9 8	8 5	7 1	5 6	3 10
fifth diagonal line	...	...	...	...	...	9 8½	8 4	7 3½

BODIES OF A BRIG CUTTER, CARRYING 24 GUNS AND $399\frac{4}{94}$ TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers	⊕		D		H		M		Q		U		X	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
Station from the foremost perpendicular	48	6	40	6	32	6	24	6	16	6	8	6	4	6
Height of the topside	18	6	18	7	18	9	19	2½	19	10½	20	11	21	6
cutting down line	2	1	2	2	2	3	2	6	3	2	6	0	9	3
Main or topside half-breadth	15	0	14	11	14	6½	13	9½	12	4½	9	4	6	6
Aftside of the rabbet of the stem above the upper edge of the rabbet of the keel	...		...		...		...		0	3	2	7½	6	4
Length on the first diagonal line	6	8½	6	8½	6	7	6	2	5	3½	3	1½	1	2
second diagonal line	10	3	10	3	10	0	9	6½	8	4¾	5	7½	3	6½
third diagonal line	14	2½	14	2½	14	0	13	5	12	1½	8	11½	6	5
fourth diagonal line	16	7	16	7	16	4	15	8½	14	2½	10	9	7	10½
fifth diagonal line	18	5½	18	5½	18	1½	17	4	15	7½	11	11	8	3

IN THE FORE AND AFTER BODIES.

Names of the Diagonals	1st		2d		3d		4th		5th	
Height up the middle line	8	1	12	1½	16	10	20	8	25	11½
Distance from the middle line on the base line or upper edge of rabbet	5	0	12	0						
Height up the side line	...		...		4	0	9	2	14	5

IN THE AFTER BODY.

Numbers of the Timbers	4		8		12		16		18		20		22		24		*Tuck*	
Station from the after perpendicular	45	6	37	6	29	6	21	6	17	6	13	6	9	6	5	6		
Height of the top-timber line	18	8	19	0½	19	8	20	5	20	10	21	5	22	0	22	9½		
topside line	...		20	0	20	6½	21	3½	21	9	22	6½	22	11½	23	11½		
cutting down line	2	1	2	3	2	10½	4	3½	5	4¾	7	1	9	6½	12	10½		
Main or topside half-breadth	14	11	14	9	14	3	13	6	13	0	12	4½	11	7½	10	10		
Length on the first diagonal line	6	5½	6	1	5	4½	4	2	3	5¼	2	5½	1	4½				
second diagonal line	9	11½	9	6¼	8	7	7	2	6	2	4	11½	3	3½	1	2		
third diagonal line	14	1½	13	8	12	9¼	11	4½	10	4	9	2½	7	6½	5	6¾	4	2½
fourth diagonal line	16	4¾	16	0½	15	3½	14	3½	13	6½	12	8	11	6½	10	2½	9	0½
fifth diagonal line	18	2½	17	10¾	17	3¼	16	6	15	11	15	3¾	14	6	13	7½	12	8¼

BODIES OF A CUTTER, ON A NEW CONSTRUCTION, OF 273 TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers......	⊕	D	F	H	K	M	N
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
Station from the foremost perpendicular........	32 11	24 3	19 11	15 7	11 3	6 11	4 9
Lower height of breadth, and upper height of breadth..	11 4½	11 6¾	11 9	12 1	12 6½	13 2½	13 7
Height of the top-timber line, or topside line	16 1½	16 5½	16 8½	17 0½	17 5¼	17 10½	18 1½
Height of the cutting down line	1 2½	1 4	1 6	1 10	2 6	4 1	5 8½
Main half-breadth................................	14 7½	14 3	13 7½	12 7	10 10½	8 2	6 4
Top-timber half-breadth, and topside half-breadth..	14 3½	13 11	13 4¾	12 5¾	10 11	8 5	6 9
Length of the lower breadth sweep............	6 7	5 7¾	4 11½	4 1½	3 8½	3 4	3 0
Length on the first diagonal line................	6 8½	6 5¼	6 0	5 5¾	4 4½	2 11½	1 11¾
second diagonal line............	8 11	8 6	7 9½	6 11½	5 8½	4 1½	3 1½
third diagonal line...............	11 4	10 9	9 10½	8 10½	7 5½	5 8	4 5½
fourth diagonal line..............	13 5	12 8½	11 9	10 6¾	9 1¼	6 11½	5 6¾
fifth diagonal line................	15 2½	14 6	13 8	12 4½	10 10	8 4½	6 8½

IN THE FORE AND AFTER BODIES.

Names of the Diagonals.................................	1st	2d	3d	4th	5th
Height up the middle line.........................	7 4	9 7	11 10	13 6½	15 3
Distance from the middle line on the base line or upper edge of the rabbet	3 6¼	7 0½	10 10½		
Height up the side line................................	...	...	...	1 1	4 11

IN THE AFTER BODY.

Numbers of the Timbers........................	4	8	10	12	14	16	18	*Tuck*
Station from the after perpendicular............	36 5	27 9	23 5	19 1	14 9	10 5	6 1	
Lower height of breadth, and upper height of breadth..	11 4¾	11 7¾	11 10	12 1	12 5¼	12 10½	13 6	
Height of the top-timber line, or topside line...	16 0½	16 2½	16 4¾	16 7½	16 11	17 3¾	17 8¾	
Height of the cutting down line	1 3¼	1 7½	1 11½	2 7	3 7	5 3	8 0	
Main half-breadth................................	14 6	13 11	13 5	12 9	11 11½	11 0	9 10	7 8
Top-timber half-breadth, or topside half-breadth..	14 2	13 7	13 1	12 5	11 7½	10 8	9 6	
Length of the lower breadth sweep............	6 7½	6 0¾	4 11½	3 6	2 7¼	2 0½	1 10½	
Length on the first diagonal line.................	6 8	6 4¼	5 11½	5 5½	4 6¾	3 4	1 5½	
second diagonal line............	8 10	8 4¼	7 9½	6 11½	5 10¼	4 4½	2 5¾	0 9¾
third diagonal line...............	11 2½	10 7	9 10½	8 10½	7 6½	5 10¾	3 11	2 4½
fourth diagonal line..............	13 3½	12 6½	11 9	10 7½	9 1½	7 5¼	5 6	4 1½
fifth diagonal line................	15 0½	14 4¾	13 6½	12 5¼	11 0	9 4½	7 6½	6 4½

BODIES OF AN EAST INDIA SHIP OF 1257$\frac{30}{94}$ TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers.......	⊕		B		F		K		O		S		X		Z		&	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
Station from the foremost perpendicular........	78	2	67	0½	56	6½	46	0½	35	6½	25	0½	14	6½	9	3½	4	0½
Lower height of breadth..........................	22	7	22	8	22	9½	23	0	23	3½	23	11	25	6½	27	0	28	10
Height of the top-timber line....................	36	0	36	1	36	2½	36	5½	36	9½	37	2	37	7	37	11	38	4
topside line........................	...		...		...		...		37	5½	37	10	38	3	38	5	39	0
cutting down line..................	1	8½	1	8¾	1	9½	1	11	2	3½	3	0	4	7½	...		...	
rising line	1	0½	1	0¾	1	2	1	5	2	0	3	0						
Main half-breadth..................................	20	7	20	6½	20	6	20	3½	20	0½	19	5½	17	6	15	2	10	6
Top-timber half-breadth..........................	19	1	19	0¾	19	0½	18	9¾	18	6½	18	0	16	9	15	5½	12	7
Rising half-breadth	8	9½	8	9	8	8	8	4	7	7½	6	0						
Length of the floor sweep above the rising.....	10	7	10	7	10	7	10	7	10	7	10	7						
Length on the first diagonal line..................	14	1½	14	0	13	10½	13	4¾	12	6½	10	9½	7	4	4	0		
second diagonal line............	21	10¼	21	9	21	8¼	21	3	20	5½	18	7	14	4½	10	10	4	7½
third diagonal line...............	24	6¼	24	5½	24	4½	24	0½	23	5	22	2	19	0	15	7	9	8½
fourth diagonal line.............	24	11½	24	11½	24	11	24	6½	24	0½	23	1½	20	5	17	4½	11	7½

IN THE FORE AND AFTER BODIES.

Names of the Diagonals.................................	1st		2d		3d		4th	
Height up the middle line..........................	9	7½	18	9	26	9½	31	2
Distance from the middle line on the base line or upper edge of rabbet.........................	13	3						
Height up the side line..............................	...		4	7	12	0	16	8

IN THE AFTER BODY.

Numbers of the Timbers..........................	4		8		12		16		20		24		28		30		31	
Station from the after perpendicular............	76	3	65	9	55	3	44	9	34	3	23	9	13	3	8	0	4	1
Lower height of breadth..........................	22	8	22	10	23	1	23	5	23	9½	24	3½	25	1½	25	9½	26	7
Height of the top-timber line....................	36	1	36	3½	36	6½	36	9½	37	3½	37	9½	38	5	38	9	39	0½
topside line........................	...		...		...		...		40	0½	40	6½	41	2	41	6	41	9½
cutting down line.................	1	9	1	10	2	1	2	6	3	2½	4	3	6	0	8	10		
rising line	1	1	1	4	1	10	2	8	4	0½								
Main half-breadth..................................	20	6	20	2½	19	9½	19	3	18	6½	17	7½	16	5	15	8	14	11½
Top-timber half-breadth..........................	18	11½	18	8½	18	4	17	9½	17	1	16	1½	14	11¼	14	4	13	9
Rising half-breadth..............................	8	9	8	6	8	0	7	1	5	10								
Length of the floor sweep above the rising.....	10	7	10	7	10	7	10	7	10	7								
on the first diagonal line................	14	0	13	8	12	10½	11	7½	9	11	7	6½	4	2	2	2½	0	10
on the second diagonal line............	21	9	21	5½	20	9	19	7½	17	9	14	8¼	10	2½	6	10½	3	6
on the third diagonal line...............	24	5	24	1¼	23	6	22	6	21	3	19	1½	15	10½	13	0½	9	6¼
on the fourth diagonal line	24	10	24	6½	23	11½	23	1½	22	1½	20	9	18	7¼	16	7¾	14	1½

BODIES OF AN EAST INDIA SHIP OF 1000 TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers	⊕		B		F		K		O		S		U		X	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
Station from the foremost perpendicular	70	6	54	9	44	9	34	9	24	9	14	9	9	9	4	9
Lower height of breadth	19	10	19	11	20	2¼	20	6	21	2½	22	10	24	1	25	9½
Height of the top-timber line	31	7	31	8	32	0	32	6½	32	10	33	4	33	10	34	4
topside line	...		...		...		...		35	5	36	0	36	9	37	5
cutting down line	1	8	1	9	1	9½	1	11	2	4	3	4	4	3	5	6
rising line	1	0½	1	1	1	3	1	5½	2	5						
Main half-breadth	18	8	18	7½	18	7	18	5¼	18	1½	16	8	14	7	11	0½
Top-timber half-breadth	17	2½	17	2¼	17	1	16	11	16	7½	15	8½	14	7¾	12	4¼
Rising half-breadth	8	2½	8	2	7	11	7	4	5	11						
Length of the floor sweep above the rising	9	5	9	5	9	5	9	5	9	5						
on the first diagonal line	8	5½	8	5½	8	2	7	10½	7	2¼	4	10½	2	3		
second diagonal line	13	8½	13	6¾	13	2½	12	7½	11	3½	8	0	5	0½		
third diagonal line	19	2	19	1	18	9	18	1	16	6	12	7½	9	6¾	4	4
fourth diagonal line	21	5½	21	5½	21	2	20	8½	19	6	16	5½	13	7¾	8	5½
fifth diagonal line	20	1¾	20	1¾	20	0½	19	9½	19	2½	17	3	14	9	9	10½

IN THE FORE AND AFTER BODIES.

Names of the Diagonals	1st		2d		3d		4th		5th	
Height up the middle line, Fore Body	6	9½	10	1½	15	8½	21	4	23	6
Height up the middle line, After Body	6	9½	10	1½	15	8½	23	1½	30	6
Distance from the middle line on the base line or upper edge of rabbet	6	3	11	9						
Height up the side line	...		...		0	5	8	8	15	9

IN THE AFTER BODY.

Numbers of the Timbers	4		8		12		16		20		24		28		29		30	
Station from the after perpendicular	67	11½	57	11½	47	11½	37	11½	27	11½	17	11½	7	11½	5	5½	3	0
Lower height of breadth	19	11½	20	2	20	5	20	10	21	3	22	0	23	5	24	0	24	8
Height of the top-timber line	31	8½	31	11	32	2½	32	7	33	0½	33	7½	34	3	34	5½	34	8
topside line	...		...		...		...		37	2	37	9	38	4	38	7	38	10
cutting down line	1	9	1	11	2	1	2	6	3	1	4	3	6	7	7	7	8	9
rising line	1	3	1	6	2	1	3	2½										
Main half-breadth	18	6¾	18	4¼	18	0½	17	6	16	8	15	7½	14	5¼	14	1½	13	9½
Top-timber half-breadth	17	1	16	9½	16	6¼	15	11¼	15	2	14	1½	12	11½	12	7½	12	3½
Rising half-breadth	8	0¾	7	10	7	4	6	5										
Length of the floor above the rising	9	5	9	5	9	5	9	5										
on the first diagonal line	8	2¼	7	11½	7	7	6	11	5	10	4	3½	1	11	1	3	0	6
second diagonal line	13	3	12	10¾	12	1	10	9	9	1½	6	7	3	0½	2	0	0	9
third diagonal line	18	9½	18	5½	17	8¼	16	3¼	14	0½	10	10	5	11	4	2	1	11
fourth diagonal line	22	3½	21	11½	21	5	20	4½	18	9½	16	5	11	4	9	3	6	4
fifth diagonal line	23	7	23	4	22	11	22	1½	20	11½	19	7	17	5½	16	4	14	5

BODIES OF AN EAST INDIA SHIP OF 800 TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers......	⊕	B	F	K	O	S	U	W	X
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
Station from the foremost perpendicular........	62 2	52 1	41 10	31 7	21 4	11 6½	6 5	4 0	
Lower height of breadth........................	20 7	20 8	20 9½	21 1	21 6	22 8	23 10	24 9	25 9½
Height of the top-timber line....................	33 5½	33 6	33 7	33 11	34 3½	34 11	35 3½	35 6	35 9
topside line........................	...	...	...	34 7	34 11½	35 7	35 11½	36 2	36 5
cutting down line.................	1 7½	1 8	1 9½	2 0¼	2 8½	5 3			
rising line........................	0 11	0 11½	1 3	1 9¾	2 11				
Main half-breadth................................	17 8	17 7¾	17 7	17 5	16 10	14 7½	11 10½	9 4½	5 3½
Top-timber half-breadth..........................	16 3	16 2½	16 1½	15 10½	15 5½	14 5½	12 10½	11 4¾	9 3
Rising half-breadth..............................	7 8¾	7 8½	7 7	7 2	5 8¾				
Length of the floor sweep above the rising....	8 8	8 8	8 8	8 8	8 8				
on the first diagonal line.................	13 1	13 0½	12 8½	11 10	8 7	5 10½	1 6		
second diagonal line............	17 3	17 2½	16 11	16 2½	14 4½	9 6¾	5 0	1 3½	
third diagonal line..............	19 8	19 7½	19 5½	18 11½	17 8	13 9	9 6½	6 3	
fourth diagonal line............	20 6	20 5½	20 4½	20 0½	19 3	16 4	13 0½	10 1	5 0½

IN THE FORE AND AFTER BODIES.

Names of the Diagonals................................	1st	2d	3d	4th
Height up the middle line { Fore Body.......	9 4½	13 7	19 6	26 1
Height up the middle line { After Body......	9 4½	13 7	21 10	26 1
Distance from the middle line on the base line or upper edge of the rabbet........................	11 10			
Height up the side line...........................	...	0 10	8 9	15 6

IN THE AFTER BODY.

Numbers of the Timbers.........................	(4)	4	8	12	16	20	24	26	28
Station from the after perpendicular............	73 8	63 5	53 2	42 11	32 8	22 5	12 7½	7 6	3 0
Lower height of breadth.........................	20 7	20 9	21 0½	21 5¼	21 10½	22 5	23 2	23 8½	24 3½
Height of the top-timber line.....................	33 5¾	33 6	33 11	34 3½	34 8½	35 3½	36 0	36 5	36 8
topside line.......................	...	...	...	35 6½	35 11½	37 8½	38 5	38 10	39 1
cutting down line................	1 8	1 9¼	2 0	2 5½	3 2	4 4½	6 3	8 6	
rising line........................	0 11¼	1 3½	1 9	2 7	3 9½	5 7½			
Main half-breadth................................	17 8¼	17 6½	17 3	16 8½	16 0½	15 1	13 11	13 3¾	12 8½
Top-timber half-breadth..........................	16 2	15 11½	15 8½	15 3	14 6	13 7	12 6	11 10	11 3
Rising half-breadth..............................	7 8½	7 7¾	7 5	6 9	5 5½	3 2½			
Length of the floor sweep above the rising......	8 8	8 8	8 8	8 8	8 8	8 8			
on the first diagonal line.................	13 0¼	12 8	11 11½	10 10	9 4	7 1½	4 3	2 5¾	0 11½
second diagonal line............	17 2¾	16 11	16 4½	15 3½	13 5½	10 6½	6 9	4 1½	1 7½
third diagonal line...............	20 10¾	20 8½	20 3½	19 5	18 0¾	15 10¾	12 6	9 8	6 0
fourth diagonal line.............	20 5¾	20 5¼	19 11½	19 3½	18 5	17 1	15 1	13 8	10 11

BODIES OF A MERCHANT SHIP OF 544 $\frac{64}{94}$ TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers......	⊕		B		F		K		O		Q		R	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
Station from the foremost perpendicular........	50	10	41	8	32	0	22	4	12	8	7	10	5	5
Lower height of breadth..........................	17	6	17	6½	17	8	18	1	19	0	19	11	20	6
Height of the top-timber line..........	24	8½	24	9	24	10½	25	0½	25	6½	25	10½	26	0½
topside line	...		...		...		28	8½	29	2½	29	6½	29	8½
cutting down line	1	6	1	7	1	9½	2	5	3	9				
Main half-breadth................................	15	8	15	8	15	7	15	3	13	10¼	11	9	9	11
Top-timber half-breadth..........................	14	11½	14	11½	14	10½	14	7½	13	8¼	11	11	10	4
Length on the first diagonal line	13	0½	13	0½	12	7½	11	5	8	10	6	0	4	0
second diagonal line............	18	0½	18	0½	17	6	16	4	12	11¼	9	9	7	5
third diagonal line.............	20	9½	20	9½	20	3	19	6	16	4½	13	2	10	5
fourth diagonal line.............	21	8½	21	8½	21	5	20	10	18	6	15	7	12	11½

IN THE FORE AND AFTER BODIES.

Names of the Diagonals..................................	1st		2d		3d		4th	
Height up the middle line	10	5	15	8½	21	3½	26	9
Distance from the middle line on the base line or upper edge of the rabbet....................	10	5	15	8½				
Height up the side line	...		...		5	8	11	3½

IN THE AFTER BODY.

Numbers of the Timbers	4		8		12		16		20		24		26		27	
Station from the after perpendicular............	59	11	50	3	40	7	30	11	21	3	11	7	6	9	4	4
Lower height of breadth..........................	17	8	17	11	18	3½	18	9½	19	6	20	9	21	9	22	4½
Height of the top-timber line....................	24	11	25	2½	25	6½	26	0	26	7½	27	3½	27	8	27	10½
topside line..........................	...		...		...		30	4	30	10	31	3½	31	8	31	10½
cutting down line	1	7	1	9¼	2	2¼	2	10	3	11	5	8½	7	0½	7	10½
Main half-breadth................................	15	7	15	5½	15	2	14	7	13	10	12	8½	12	0	11	7
Top-timber half-breadth..........................	14	10	14	7½	14	4½	13	10	13	1½	12	1	11	5¼	11	1
Length on the first diagonal line................	12	10	12	5½	11	7½	10	5½	8	9¼	5	8½	3	4¾	1	11
second diagonal line............	17	10	17	5½	16	7½	15	3½	13	2½	9	7	6	4	4	0¾
third diagonal line..............	20	8½	20	4	19	10	19	0	17	0¼	13	5¾	10	4½	8	0
fourth diagonal line............	21	8½	21	5	21	0	20	3	19	0	16	7¼	14	2¾	12	5

BODIES OF A MERCHANT SHIP OF 441 $\frac{35}{94}$ TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers......	⊕		(B)		D		H		M		Q		S		U	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
Station from the foremost perpendicular........	51	10	47	11	39	1	30	3	21	5	12	7	8	2	3	9
Lower height of breadth..........................	17	2½	17	3	17	4	17	6½	17	9½	18	5	19	0	20	0
Height of the top-timber line.....................	26	6½	26	6¾	26	8	26	10½	27	2	27	8	28	1	28	6
topside line.........................	...		...		...		27	10½	28	2	28	8	29	1	29	6
cutting down line..................	1	6	1	6¼	1	7	1	9½	2	3	3	2				
rising line............................	9	0	9	0½	9	1½	9	6½	10	4						
Main half-breadth..................................	14	3	14	2¾	14	2	14	0	13	8	12	7	11	0¾	7	11
Top-timber half-breadth..........................	13	8¼	13	8	13	7¼	13	6	13	2	12	6	11	6	9	6
Rising half-breadth..................................	5	5½	5	4½	5	2	4	9	3	11						
Length on the first diagonal line.................	5	8½	5	8	5	6	5	1	4	6	3	0½	1	1		
second diagonal line.............	11	6½	11	6	11	3	10	8	9	5¼	6	10	4	6		
third diagonal line...............	14	2½	14	2	13	10	13	3½	12	1	9	4	6	9½	2	6½
fourth diagonal line..............	16	0½	16	0	15	8	15	2	14	1	11	6	8	11	4	7½
fifth diagonal line................	18	1	18	0¾	17	10½	17	8	16	10½	14	11	12	8	8	6

IN THE FORE AND AFTER BODIES.

Names of the Diagonals....................................	1st		2d		3d		4th		5th		6th	
Height up the middle line.........................	4	1	8	7	11	7½	14	7½	21	6	25	0
Distance from the middle line on the base line or upper edge of rabbet.......................	4	10	10	10½								
Height up the side-line...........................	...		...		0	3¾	4	1	10	1	13	0

IN THE AFTER BODY.

Numbers of the Timbers............................	4		8		12		16		20		22		23		24	
Station from the after perpendicular............	47	5	38	7	29	9	20	11	12	1	7	8	5	5½	3	3
Lower height of breadth	17	6	17	9	18	2	18	7	19	4	19	11	20	4	20	10
Height of the top-timber line.....................	26	10	27	1	27	5	27	11	28	5	28	9	28	11	29	1
topside line.........................	27	10	28	1	28	5	28	11	29	5	29	9	29	11	30	1
cutting down line..................	1	7	1	8½	2	1	2	9½	4	4½	6	1½	8	0½		
rising line............................	9	2	9	6	10	1½	11	2½								
Main half-breadth..................................	14	3	14	1½	13	10¼	13	3½	12	5	11	9	11	5	11	0½
Top-timber half-breadth..........................	13	8½	13	7	13	3¾	12	9½	11	10½	11	3	10	10½	10	6
Rising half-breadth..................................	5	3¼	4	10½	4	2										
Length on the first diagonal line.................	5	6¼	5	3	4	8½	3	11	2	3	1	3½	0	9¼	0	5
second diagonal line.............	11	3½	10	9½	9	9	8	0	5	1½	3	1½	2	0	0	10½
third diagonal line...............	13	10¾	13	5¼	12	5½	10	6½	7	4	4	10½	3	5¼	1	8
fourth diagonal line..............	15	9	15	3½	14	4½	12	9½	9	6½	7	0	5	4½	3	0¾
fifth diagonal line................	17	11	17	7½	17	1	16	0¼	13	10	12	0¾	10	9½	8	10¾
sixth diagonal line................	18	7	18	4	17	10½	17	1	15	6	14	2½	13	5	12	4

BODIES OF A MERCHANT SHIP OF 329 $\frac{80}{94}$ TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers......	⊕		D		H		M		O		Q		R	
	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.
Station from the foremost perpendicular........	42	8	32	4	23	8	15	0	10	8	6	4	4	2
Lower height of breadth........................	15	1	15	3½	15	9½	16	9½	17	5½	18	3½	18	9
Height of the top-timber line.....................	22	7½	22	9	23	2	23	10½	24	5	25	0	25	5
topside line........................	...		...		24	4	25	0½	25	7	26	2	26	7
cutting down line..................	1	4	1	5	1	8	2	3	3	3				
Main half-breadth................................	13	6	13	6	13	4½	12	9	11	10	10	2	8	5
Top-timber half-breadth..........................	12	0	12	0	11	10½	11	7½	11	3	10	3	9	0
Topside half-breadth............................	...		...		11	10½	11	7½	11	2½	10	3½	9	1½
Length on the first diagonal line.................	6	2½	6	0½	5	8½	4	10½	3	6	1	1		
second diagonal line.............	10	4½	10	1½	9	6	8	0½	6	5	3	10	1	8½
third diagonal line...............	13	1½	12	11	12	2½	10	4	8	7½	5	10½	3	7½
fourth diagonal line..............	14	10	14	7½	14	1	12	1½	10	5½	7	8	5	3½
fifth diagonal line................	15	5½	15	5	14	11½	13	8½	12	6	10	1	7	9
sixth diagonal line...............	15	5½	15	5½	15	1½	14	3½	13	3	11	0½	8	10

IN THE FORE AND AFTER BODIES.

Names of the Diagonals................................	1st		2d		3d		4th		5th		6th	
Height up the middle line........................	5	4	8	7	11	3½	13	4½	17	3	19	10½
Distance from the middle line on the base line or upper edge of rabbet........................	4	6	8	4	11	2						
Height up the side-line..........................	...		...		...		4	6	9	7	12	6

IN THE AFTER BODY.

Numbers of the Timbers........................	4		8		12		16		20		24		25	
Station from the after perpendicular............	50	4	41	8	33	0	24	4	15	8	7	0	4	10
Lower height of breadth	15	3	15	8	16	2	16	10½	18	0	19	3	19	7½
Height of the top-timber line.....................	22	8½	23	0	23	5½	24	0	24	9	25	9	26	0
topside line........................	...		24	3	24	8½	26	4½	27	1½	28	0	28	3
cutting down line.................	1	4½	1	6½	1	11	2	7	4	9	6	1		
Main half-breadth................................	13	6	13	3	12	11	12	4½	11	7	10	6	10	2
Top-timber half-breadth..........................	11	11	11	9	11	5½	11	0	10	4½	9	4	9	0½
Topside half-breadth	11	11	11	9	11	2	10	8½	10	0	8	11	8	7
Length on the first diagonal line	6	0	5	8	5	0½	4	0½	2	7	0	10½	0	6
second diagonal line.............	10	1½	9	6½	8	7	6	11½	4	6½	1	6½	0	10½
third diagonal line...............	12	10½	12	3½	11	2½	9	4½	6	6	2	9	1	9
fourth diagonal line..............	14	7	14	1	13	2½	11	5½	8	7	4	2	2	8½
fifth diagonal line...............	15	2	14	9½	14	3	13	2	11	4½	7	8	5	9
sixth diagonal line...............	15	2½	14	10½	14	5½	13	8	12	5	9	9	8	8

A POST OFFICE PACKET OF $201\frac{64}{94}$ TONS, AND A FAST SAILING SCHOONER OF $133\frac{6}{94}$ TONS.

IN THE FORE BODY.

Of the Packet.

Distinguishing Characters of the Timbers	⊕	D	H	M	O	P	Q
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
Station from the foremost perpendicular	34 5	26 10	18 10	10 10	6 10	4 10	2 10
Lower height of breadth	11 0	11 1	11 5¾	13 5	15 1	16 2¾	17 8
Heights of the topside or top-timber line	15 7	15 5½	15 5	15 8	16 0	16 1¾	16 4½
cutting down line	1 1½	1 1¾	1 3¾	2 3½	3 8½	5 0	7 0
lower edge of the rabbet of the stem	...	...	...	0 8½	1 11½	3 1½	4 10
Main half-breadth	12 3½	12 2¾	11 8½	10 2	8 6½	7 4½	5 9½
Top-timber half-breadth	12 0	11 11¼	11 6	10 0½	8 6½	7 4½	5 9½
Length of the lower breadth sweeps	8 0	8 1	9 0	10 0	11 0		
Length on the first diagonal line	5 11	5 11	5 7¾	4 5½	3 3¾	2 4½	1 2
second diagonal line	7 11¼	7 11¼	7 6	5 11½	4 6	3 5	2 1
third diagonal line	10 1¾	10 1¼	9 7½	7 9¼	5 10½	4 7¾	3 1
fourth diagonal line	11 10½	11 9¼	11 3	9 1¾	7 0	5 7	3 10½
fifth diagonal line	12 9½	12 8¼	12 1	9 11¾	7 10½	6 3¾	4 5½
sixth diagonal line	12 11½	12 9¾	12 4	10 4¾	8 5¼	6 10	4 11¾

Of the Schooner.

Distinguishing Characters of the Timbers	⊕	C	G	L	N	P
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
Station from the foremost perpendicular	38 0	30 0	22 0	14 0	10 0	6 0
Lower height of breadth	9 5	9 3	9 3	9 5	9 6½	9 9
Heights of the topside or top-timber line						
cutting down line	0 10½	1 0	1 2½	1 5¾	1 9¾	2 11
lower edge of the rabbet of the stem						
Main half-breadth	10 1	9 11	9 6	8 5½	7 4½	5 6
Top-timber half-breadth						
Length of the lower breadth sweeps						
Length on the first diagonal line	2 10½	2 10	2 6½	1 11½	1 4½	0 6½
second diagonal line	5 5¼	5 4½	4 10	3 10¼	3 0	1 9
third diagonal line	8 0½	7 11½	7 3¼	5 11½	4 11	3 5½
fourth diagonal line	9 4	9 3	8 6½	7 0	5 9½	4 2
fifth diagonal line	10 2½	10 1½	9 6	8 0½	6 8½	4 11½
sixth diagonal line	10 7	10 5¾	9 11½	8 8½	7 5½	5 6½

IN THE FORE AND AFTER BODIES.

Of the Packet. — *Of the Schooner.*

Names of the Diagonals	1st	2d	3d	4th	5th	6th	1st	2d	3d	4th	5th	6th
Height up the middle line	6 6½	8 4½	10 4½	11 11	13 2½	14 5½	2 10¼	5 5	7 11	8 11	9 10½	10 10
Distance from the middle line on the base line or upper edge of the rabbet	3 8	7 10½	12 3½	...	...	...	2 7¾	4 11½	7 3			
Height up the side line	...	...	...	3 9	7 0	9 11	...	...	...	1 2	4 3½	7 0

IN THE AFTER BODY.

Of the Packet.

Numbers of the Timbers	4	8	12	16	18	20	*Tuck*
Station from the after perpendicular	37 0	29 0	21 0	13 0	9 0	5 0	...
Lower height of breadth	11 3¾	11 9¾	12 6¼	13 6	14 0	14 7½	...
Heights of the topside or top-timber line	15 10½	16 3¾	16 11	17 9	18 2½	18 8½	...
cutting down line	1 2	1 5½	2 3½	4 3	5 9	7 8	...
lower end of the tuck upon the post	...	...	...	...	...	...	8 6
Main half-breadth	12 3	12 0½	11 7½	10 8½	10 1¼	9 4½	8 7
Top-timber and topside half-breadth	11 10¾	11 8½	11 3¼	10 4	9 9	9 0½	8 3
Length of the lower breadth sweep	7 3	6 9	6 1	5 0	4 2	2 11	...
Length on the first diagonal line	5 8¼	5 2	4 5	3 1½	2 3	1 0	...
second diagonal line	7 8	6 10¾	5 9	4 1	2 10	1 5	...
third diagonal line	9 9¼	9 0	7 7¼	5 8¼	4 3¼	2 7¼	1 2½
fourth diagonal line	11 5	10 8½	9 5	7 4½	5 10	4 0	2 7½
fifth diagonal line	12 4½	11 10½	10 10	9 0	7 7½	5 8¾	4 4½
sixth diagonal line	12 9	12 5	11 8¾	10 4½	9 5	7 9½	6 4¾

Of the Schooner.

Numbers of the Timbers	1	5	9	13	15	16	*Tuck*
Station from the after perpendicular	35 0	27 0	19 0	11 0	7 0	5 0	
Lower height of breadth	9 7	10 0	10 6½	11 3½	11 7	11 9½	
Heights of the topside or top-timber line	...	10 6	11 4½	12 7	13 4	13 8½	
cutting down line	0 10½	1 1	1 11	2 10	4 2	5 10	
lower end of the tuck upon the post							
Main half-breadth	10 1	9 10	9 1½	7 11	7 2¼	6 8½	
Top-timber and topside half-breadth	...	9 10	9 1	7 9½	6 11½	6 6½	
Length of the lower breadth sweep	10 6	6 9	4 8½	3 1	2 2½	1 10	
Length on the first diagonal line	2 10	2 4¾	1 7½	0 8¾	0 3¼		
second diagonal line	5 3½	4 7	3 3	1 8½	0 10	0 3½	
third diagonal line	7 10	6 10	5 2½	3 4¼	2 1	1 3½	
fourth diagonal line	9 2	8 2	6 4¾	4 2½	2 9	1 11	0 8½
fifth diagonal line	10 1¼	9 3½	7 8	5 5½	3 9	2 10	1 5
sixth diagonal line	10 6¼	9 11½	8 9½	6 10½	5 3½	4 4	2 5½

BODIES OF A BRIG COLLIER OF $170\frac{27}{94}$ TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers.......	⊕		D		F		H		K		L		M		N	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
Station from the foremost perpendicular........	30	0	22	5	18	5	14	5	10	5	8	5	6	5	4	5
Lower height of breadth	9	7	9	10	10	3	10	9¾	11	8	12	2½	12	10	13	9
Upper height of breadth........................	12	1¼	12	1½	12	2½	12	6	13	0	13	4¼	13	9	14	3¼
Height of the top-timber line....................	16	4	16	4½	16	6	16	8	16	11	17	1½	17	4	17	8
topside line........................	...		...		17	3	17	5½	17	9	17	11¼	18	2¼	18	6
cutting down line.................	1	2	1	2	1	3	1	6	2	2	2	11	4	4		
Main half-breadth..............................	11	3	11	3	11	3	11	1¾	10	8	10	2	9	5½	8	1
Toptimber half-breadth...........................	10	6	10	6	10	6	10	4½	10	2	9	11	9	4½	8	4½
Length down the first diagonal line.............	8	1	7	11½	7	8½	7	3	6	3½	5	6½	4	6	2	6½
second diagonal line..........	13	3	13	0	12	8	11	11	10	9	9	9	8	6	6	6
third diagonal line............	17	7	17	5	17	0½	16	2½	14	10	13	8¾	12	3½	10	3½
fourth diagonal line...........	17	3½	17	2	16	11	16	4½	15	3¾	14	4	13	0¾	11	2

IN THE FORE AND AFTER BODIES.

Names of the Diagonals.................................	1st		2d		3d		4th	
Height up the middle line	7	4	12	3½	17	5¼	19	8¾
Distance from the middle line on the base line or upper edge of the rabbet....................	4	5½	7	5¾	10	7¾		
Height up the side line	...		...		...		6	0

IN THE AFTER BODY.

Numbers of the Timbers	4		8		12		14		16		18		20		22	
Station from the after perpendicular............	38	11	30	11	22	11	18	11	14	11	10	11	6	11	2	11
Lower height of breadth..........................	9	8	10	0¾	10	9	11	2¾	11	9½	12	6½	13	5¾	14	8¼
Upper height of breadth.........................	12	2	12	4½	12	10¼	13	2½	13	7½	14	1¾	14	9	15	6½
Height of the top-timber line.....................	16	5	16	7¾	16	11¾	17	3	17	6½	17	10¾	18	3½	18	9½
topside line........................	...		17	5¼	17	9	18	0½	18	4	18	8	19	0¾	19	7¼
cutting down line................	1	2½	1	4	1	7	1	10	2	3¼	2	11¾	4	4¼		
Main half-breadth................................	11	2¾	11	1	10	10½	10	8¼	10	5½	10	2½	9	10½	9	5½
Top-timber half-breadth...........................	10	5¼	10	3½	10	0½	9	10	9	7½	9	4¼	9	0	8	7
Length down the first diagonal line.............	7	11½	7	7½	6	10	6	3¾	5	6½	4	7½	3	2½	1	3
second diagonal line..........	13	0½	12	6	11	4¼	10	7	9	7	8	3½	6	6½	3	9½
third diagonal line............	17	4½	16	10	15	7½	14	9	13	9	12	5	10	8	7	11
fourth diagonal line...........	17	2	16	9½	16	1	15	5¾	14	9½	13	9½	12	7¼	10	5

BODIES OF A COASTING SLOOP OF 60 TONS.

IN THE FORE BODY.

Distinguishing Characters of the Timbers......	⊕		A		C		E		F		G	
	ft.	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*	*ft.*	*in.*
Station abaft the foremost perpendicular.......	19	5	15	8½	11	5½	7	3½	5	2	3	0¾
Lower height of breadth........................	5	10	6	1½	6	7	7	4	7	11¾	8	9
Upper height of breadth........................	7	2	7	4½	7	8	8	3	8	7	9	1
Height of the top-timber line..........	10	10	10	11½	11	2½	11	6	11	9	12	0½
cutting down line................	0	10	0	10¼	1	0¼	1	6				
rising line...........................	0	5	0	6½	0	11	1	11	2	9½	4	3½
lower edge of the rabbet of the stem.............................	...		...		...		0	2½	1	2	3	4
Main half-breadth................................	8	3	8	2½	7	11½	7	3	6	5	4	9
Top-timber half-breadth.........................	7	8	7	8	7	5	6	10	6	2	4	8
Length down the first diagonal line.............	5	11	5	9½	5	2¾	4	2¾	3	1½	1	1
second diagonal line.........	7	5	7	3½	6	8½	5	7	4	4	2	3
third diagonal line...........	9	0	8	11	8	4	7	2¼	6	0	3	8
fourth diagonal line...........	9	10	9	9	9	3	8	2¾	7	1	4	10
fifth diagonal line.............	11	0	10	11½	10	6	9	6	8	5	6	2½

IN THE FORE AND AFTER BODIES.

Names of the Diagonals..........................	1st		2d		3d		4th		5th	
Height up the middle line...............	4	6	5	10½	7	7	9	4	12	3
Distance from the middle line on the base line or upper edge of rabbet.....	4	11½	6	4½						
Height up the side line.....................	...		...		0	10½	3	2½	4	9

IN THE AFTER BODY.

Numbers of the Timbers	2		4		6		8		10		12		13	
Station from the after perpendicular............	26	8	22	4	18	2½	13	11	9	10	5	7½	3	6
Lower height of breadth.........................	5	10½	6	0½	6	4	6	10½	7	8	8	8½	9	4½
Upper height of breadth	7	2½	7	4	7	7	8	0	8	6	9	3	9	8¼
Height of the top-timber line.....................	10	10	10	11½	11	2	11	5	11	9	12	3	12	7
topside line.........................	...		...		11	6	11	9	12	1	12	7	12	11
cutting down line.................	0	10¼	0	11½	1	1¾	1	6	2	2	3	8		
rising line.........................	0	7¾	0	11½	1	6	2	6	3	11½	6	0	7	7
Main half-breadth	8	1	7	11½	7	9¼	7	5	7	0	6	6	6	2
Top-timber half-breadth.................	7	8	7	6	7	4	7	0¼	6	8	6	2	5	9½
Topside half-breadth	...		...		7	3¼	6	11½	6	7½	6	1		
Length down the first diagonal line............	5	8	5	3	4	7	3	9	2	8	1	3¼		
second diagonal line.........	7	2	6	9	6	0	5	0	3	9	2	2	0	9
third diagonal line...........	8	9	7	4¼	7	9	6	8	5	5	3	7	1	10
fourth diagonal line	9	7	9	4	8	11	8	1	7	2	5	5	3	8
fifth diagonal line	10	10	10	8¾	10	4	9	9	9	0½	7	10	6	11

TABLES

OF THE

PRINCIPAL DIMENSIONS AND SCANTLINGS

OF

SHIPS AND VESSELS OF EACH CLASS,

BOTH IN THE

ROYAL NAVY AND IN THE MERCHANT SERVICE;

ACCOMPANIED WITH SUCH

DIRECTIONS AS ARE NECESSARY TO THE PRACTICAL EXPLANATION OF THEM.

The ALPHABETICAL COLUMN on one Page of each Folio is placed so as to correspond with that on the opposite Page, in order to prevent the Possibility of Mistake in passing from one Page to the other; which might, otherwise, be sometimes occasioned by an accidental unevenness in the corresponding Sheets, &c.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	
LENGTH on the GUN DECK, or Lower Deck, from the rabbet of the Stem to the rabbet of the Stern-post	193 0	188 8	182 0	176 0	159 6	146 0	160 3	154 0	137 0	129 0	A
Length on the RANGE of the DECK	......	......	......	......	......	......	......	......	......	......	B
LENGTH from the forepart of the STEM, at the height of the Hawse-holes, in King's Ships, and at the height of the Wing Transom, in Merchant Ships, to the Aft-part of the STERN-POST at the height of the Wing Transom	196 10	192 10	185 6	179 5	163 0	149 0½	164 3	158 6	140 8	132 9	C
LENGTH of the KEEL for casting the Tonnage	158 10	156 6	149 0	145 2	131 0	119 9	135 3¼	129 8	113 3	107 0	D
Length from the foremost perpendicular to the centre of Dead-flat	87 8	82 8	64 0	66 0	66 0	67 2½	70 6	66 7	61 7	58 4	E
Length from the foremost perpendicular to the foremost timber expressed in the dimensions of bodies	14 2¾	7 2½	4 0	5 6	6 0	5 5¼	3 4	5 7	3 8½	5 8½	F
Length from the after perpendicular to the after timber expressed in the dimensions of bodies	5 2½	4 4	3 4½	4 2	7 10½	5 10¾	2 2	4 9	2 10	4 2	G
LENGTH of the TREAD of the KEEL, viz. from the aft side of the Stern-post to the fore part of the Fore-foot	177 0	173 0	164 3	160 5	142 0	134 0	148 6	142 0	126 2	119 2	H
LENGTH EXTREME, from the aft side of the Taffarel, at the height of the Fiferail, to the fore part of the Figure or Stem	233 3	222 9	217 9	208 6	189 0	171 0	187 0	180 3	161 9	150 0	I
⁎ *The above lengths are taken with a line parallel with the Keel.*											
BREADTH MOULDED	52 0	49 0	49 0	48 0	43 8	39 10	40 0	38 9	37 6	34 10	K
BREADTH EXTREME *	52 10	49 10	49 8	48 8	44 4	40 6	40 8	39 5	38 2	35 4	L
DEPTH IN HOLD, *taken from the strake next the Limber-boards*	22 9	21 0	21 0	19 6	19 0	17 6	13 4	13 6	13 4	12 7	M
BURTHEN in TONS *(Builder's tonnage)*	2358	2067	1955	1828	1369	1044	1189	1071	877	710	N
LOAD DRAUGHT OF WATER { Afore	23 0	22 0	22 9	20 3	19 4	18 0	18 0	17 9	17 4	16 7	O
LOAD DRAUGHT OF WATER { Abaft	24 0	23 0	22 9	20 3	20 8	18 9	18 0	19 0	18 4	17 7	P
Height of the Lower Ports above the Water in Midships	5 6	5 0	5 6	6 0	5 6	5 3	7 0	7 8	7 8	7 0	Q
MAIN KEEL. Sided { *Afore at the Stem*	1 6	1 5	1 4	1 3	1 2	1 1½	1 2	1 2	1 2	1 1	R
MAIN KEEL. Sided { *Amidships*	1 9	1 8	1 7	1 6	1 5	1 4	1 4	1 4	1 4	1 3	S
MAIN KEEL. Sided { *Abaft at the Post or Rabbet*	1 4	1 4	1 4	1 3	1 2	1 1	1 1	1 1	1 1	1 0	T
Deep	1 9	1 8	1 7	1 6	1 5	1 4½	1 6	1 6	1 6	1 4	V
Number of Pieces; *and not to give less shift to*	*seven*	*seven*	*seven*	*seven*	6 *or* 7	*six*	*six*	*six*	*six*	*six*	W
the Scarphs of the Kelson and Mainmast than	9 0	8 0	7 0	7 0	7 0	6 0	6 0	6 0	6 0	5 6	X
Scarfs in length	5 0	4 10	4 8	4 6	4 4	4 2	4 0	4 0	4 0	3 10	Y
Lips of the Scarphs, *not more in thickness than*	0 5	0 5	0 5	0 5	0 4½	0 4⅜	0 4¼	0 4¼	0 4¼	0 4	Z
Each Scarph to be bolted *with Bolts, in number*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*six*	*six*	*six*	A
and diameter	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	B
Rabbet to be sunk in, *not more than*	0 5	0 5	0 4½	0 4½	0 4	0 4	0 3½	0 3½	0 3½	0 3¼	C
⁎ *The Rabbet in Merchant-ships is mostly in the middle of the depth of the Keel.*											
FALSE KEELS †.—Number of False Keels	*one*	*one*	*one*	*two*	*one*	*one*	*one*	*one*	*one*	*one*	D
Upper False Keel, *to be deep or thick*	0 6	0 6	0 6	0 6	0 5	0 5	0 5	0 7	0 5	0 5	E
Lower False Keel, *to be deep or thick*	......	......	......	......	......	......	......	......	......	......	F
Upper False Keel to be sided as the Main Keel, and the lower False Keel to be broad or sided	......	......	......	......	......	......	......	......	......	......	G
Number of Pieces, *and give shift to the butts of the Main Keel*	*eight*	*eight*	*eight*	*eight*	*seven*	*seven*	*seven*	*seven*	*seven*	*seven*	H
DEAD OR RISING WOOD.—*To have a sufficient number of*											

* The thickness of the bottom plank on each side is only to be added to the Moulded Breadth to complete the Extreme Breadth.

† The upper false keel, in India ships, tables or coaks on to the underside of the main keel, and the Kelson boats come through it. False keels otherwise are fastened to the main keel with dumps underneath, and keel-staples along the sides, about three feet apart, observing to shift both dumps and keel

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	120 6	114 3	108 0	89 5														
B	...	...	...	...	91 6	78 7	102 0	78 0	...	...	...	...	...	...	79 0	77 0		
C	124 0	117 7	110 0	91 7	93 7	80 5	104 8	80 6	165 6½	159 1½	146 1	124 9	120 9	103 3¾	...	...	76 3	52 0
D	99 6	94 3½	88 4½	74 10¾	74 1¾	60 8	81 6½	58 6	134 0	131 0	118 8	100 0	98 8	82 0	60 8	59 6⅛	60 8	40 6
E	54 6	52 3	44 3	34 4	36 3	34 5	48 6	32 7	78 2	70 6	62 2	50 10	51 10	42 8	34 5	38 0	30 0	19 5
F	5 0	5 0	4 1	4 5	4 9	2 9	4 6	4 9	4 0½	4 9	4 0	5 5	3 9	4 2	2 10	6 0	4 5	3 0¾
G	2 0	2 6	2 9	3 6	3 7	4 6	5 6	6 1	4 1	3 0	3 0	4 4	3 3	4 10	5 0	5 0	2 11	3 6
H	111 6	105 0	97 1	80 6	82 6	66 1	83 4	63 0	150 0	143 9	131 0	113 9	108 9	92 0	65 6	60 6	66 3	44 6
I	140 6	134 3	126 0	105 5	106 0	...	112 3	88 0	193 5	187 9	174 1	144 6	140 9	121 0	92 6	84 9	83 0	56 1
K	33 0	31 6	28 0	23 0	27 0	24 7	29 10	29 3	41 2	37 4	35 4	31 4	28 6	27 0	24 7	20 2	22 6	16 4
L	33 6	32 0	28 6	23 5	27 6	25 0	30 4	29 8	42 0	38 0	36 0	32 0	29 0	27 6	25 0	20 6	22 11	16 8
M	11 0	10 3	8 3	10 0	12 1	11 0	12 6	11 1	17 0	14 9	14 9	14 9	12 2	12 0	11 2	7 11½	10 0	9 8
N	594	513	392	218	298	201	399	273	1257	1000	818	544	441	329	201	133	170	60
O	15 6	14 6	13 0	9 1	12 3	9 0	10 2	10 10	23 9	21 0	20 0	17 6	16 0	14 3	9 0	7 3	10 9	7 0
P	16 6	15 4	13 0	10 2	12 3	11 6	14 10	10 10	23 9	21 0	20 0	17 6	16 0	14 3	11 9	9 3	10 9	9 0
Q	6 1	6 6	5 3	4 3	4 8	4 8	4 8	4 6	5 5	...	...	9 0	...	6 2	4 9	3 1		
R	1 0	0 11½	0 11	0 9½	0 11½	0 8	0 9	0 8	1 3	1 2	1 1	1 0	0 11	0 10½	0 10	0 9	0 9½	0 7
S	1 2	1 1	1 0	1 0	1 1	1 0	1 2	1 1	1 4	1 3	1 2½	1 1½	1 0½	1 0½	0 11	0 10½	1 0	0 10
T	0 11	0 10½	0 10	0 8½	0 9½	0 7	0 8	0 7½	1 3	1 2	1 0	0 11	0 10½	0 10	0 9½	0 9	0 9½	0 7
V	1 3	1 2	1 0	1 1	1 1	1 0	1 2	1 1	1 5	1 4	1 3½	1 2½	1 1½	1 1	1 0½	1 6	0 11½	0 10
W	5 or 6	*five*	*five*	*three*	*three*	*four*	*four*	*three*	*six*	*five*	*five*	*four*	*four*	*four*	*three*	*three*	*two*	*two*
X	5 6	5 0	5 0	5 0	6 0	5 0	5 0	5 0	7 0	7 0	6 0	6 0	6 0	5 0	5 0	5 0	7 0	7 0
Y	3 8	3 6	3 4	3 0	3 6	3 4	3 0	3 2	4 6	4 0	3 10	3 9	3 6	3 6	3 6	3 0	3 0	3 0
Z	0 4	0 3¾	0 3½	0 3	0 3	0 3	0 3	0 3	0 4½	0 4	0 4	0 3¾	0 3½	0 3	0 3	0 2½	0 2	0 2
A	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*
B	0 1	0 0⅞	0 0⅞	0 0¾	0 1	0 0¾	0 0¾	0 0¾	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 1	0 1	0 0⅞	0 0¾	0 0¾
C	0 3¼	0 3	0 3	0 2¾	0 3	0 2½	0 2½	0 2½	0 4½	0 4	0 3½	0 3¼	0 3	0 3	0 2¾	0 2	0 1¾	0 1½
D	*one*	*one*	*one*	*one*	*two*	*none*	*none*	*none*	*two*	*two*	*two*	*two*	*two*	*one*	*one*	*one*	*one*	
E	0 5	0 5	0 6	0 4	0 3	...	...	...	0 6	0 6	0 6	0 6	0 4	0 3	0 4	0 3	0 3	
F	...	...	...	...	0 3	...	...	...	0 4	0 4	0 4	0 4	0 3					
G	...	...	...	...	...		...	...	1 5	1 4½	1 4							
H	6 or 7	*six*	*six*	*four*	*four*	*five*	*five*	*four*	*seven*	*seven*	*six*	*five*	*five*	*four*	*four*			

staples so that they come not opposite each other. Copper, or lead, is put between the main and false keel, and the under side and sides of the lower false keel, are copper sheathed, or filled.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
DEAD OR RISING WOOD—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
pieces of Dead or Rising Wood *along the Midships, to seat the Floors, or to be thick*...........	0 10	0 10	0 9	0 8	0 7½	0 7	0 8	0 8	0 7½	0 7	A
and broad	1 10	1 10	1 9	1 9	1 8	1 8	1 7	1 7	1 7	1 6	B
The *Deadwood* afore and abaft, for the security of the heels of the half-timbers, to be tabled together, and to be wrought high enough to fay the underside of the Kelson thereon; each piece to give shift to the Scarphs of the Keel and each other, and *sided* to raise a stepping of	0 3	0 3	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	0 2¼	C
The *After Lower Piece of Deadwood* to tenon into the Inner-Post with two tenons*:—each square..	0 4	0 4	0 4	0 4	0 3½	0 3¼	0 3	0 3	0 3	0 3	D
STERNSON OR KELSON KNEE, or Knee upon the Deadwood abaft, *to be made either by the after piece of Kelson, or to scarf with hook and butt upon the after piece of Kelson. The said scarf to be long*	...	...	...	...	...	...	...	...	...	...	E
The Arm against the Transoms *to reach to the upperside of the Deck or Wing Transoms, or under side of the Lower Transom*................	*deck*	*deck*	*deck*	*deck*	*deck*	*deck*	*wing*	*wing*	*wing*	*wing*	F
The Fore and Aft Arm *to be in length*...........	22 0	21 0	20 6	20 3	20 0	19 6	19 0	18 0	16 0	13 6	G
Tapered from the size of the Kelson to be at the Head..	1 3	1 2	1 1	1 1	1 0	1 0	0 11	0 11	0 10½	0 10½	H
To be bolted *with Bolts in number or distant from each other about*..............................	2 0	2 0	1 10	1 10	1 10	1 10	1 8	1 8	1 8	1 8	I
Diameter of the said Bolts	0 1⅝	0 1⅝	0 1½	0 1½	0 1½	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1⅜	K
STEM CENTRE for sweeping the Aft side of the Stem..... { *above the upper edge of the Rabbet*......................	27 0	26 6	26 2	23 9	22 6	20 0	20 7	19 6	18 6	17 1	L
{ *Abaft the foremost perpendicular*..........................	27 9	26 9	26 3	24 0	22 9	20 3	20 9	19 9	18 1	17 3	M
Height of the forepart of the Stem above the upper edge of the Rabbet of the Keel.........	44 9	41 1	38 0	35 9	33 9	32 6	31 0	30 9	29 0	27 9	N
STEM.—The Stem to be moulded...........................	1 9	1 8	1 6	1 5	1 5	1 4	1 4	1 4	1 3½	1 3	O
To be athwart-ships or sided at the Head......	2 6	2 5	2 2	2 0	1 11	1 10	1 9	1 8	1 8	1 7	P
And to diminish from the Head to the lower side of the Lower Cheek to Upper Cheek............	1 9	1 8	1 6	1 5	1 5	1 4	1 4	1 4	1 4	1 4	Q
To be sided at the Keel...........................	1 6	1 5	1 4	1 3	1 2	1 1½	1 2	1 2	1 2	1 1	R
Number of Pieces to make the Stem	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	S
Scarphs *to be in length*†..............................	4 6	4 4	4 2	4 0	4 0	4 0	4 0	4 0	4 0	3 10	T
Lips of the Scarphs not to be more than............	0 5	0 5	0 5	0 5	0 4¾	0 4½	0 4¼	0 4¼	0 4⅛	0 4⅛	V
Bolted *with Bolts in number*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*six*	*six*	*six*	*six*	W
and diameter...	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	X
APRON.—The False Stem, or Apron, to be thick..........	1 2	1 1	1 0	0 11½	0 11	0 10½	0 10	0 9½	0 9	0 8½	Y
And broad as the Stem, if the Rabbet is in the middle; *otherwise*	2 6	2 6	2 5	2 4	2 2	2 0	1 10	1 9	1 8	1 7	Z
To give proper shift to the Scarphs of the Stem, and the Scarphs to be long.....................	1 10	1 10	1 8	1 8	1 6	1 6	1 4	1 4	1 4	1 2	A
BOLLARD or KNIGHT-HEAD TIMBERS, to be square at Head	1 5	1 4½	1 4	1 3½	1 2½	1 2	1 3	1 2	1 2	1 1	B
To be sided at the Heels..........................	1 2	1 2	1 1	1 1	1 0½	1 0	1 1	1 0	1 0	0 11	C
*** *The Heads to cast or open for securing the Bowsprit; and the Heels to run low enough down to take a Bolt in the Hook next below the Gundeck Hook.*											
To be coaked and bolted through the Apron with Bolts, in number................................	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*three*	*three*	*three*	D
and diameter...	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	1 1⅛	E
HAWSE PIECES‡—on each side, in Number.................	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*three*	*four*	F

* The After Lower Piece of Deadwood, if desired, to be of elm, and form the After-shifts of Plank, and let down upon the Keel with a groove to stop the caulking; but in small vessels, the After-piece of Keel and Deadwood may be formed of one piece.

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 18	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	0 7	0 7	0 7	0 7	0 6	0 9	0 8	0 9	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 5	0 3
B	1 5	1 4	1 3	1 2	1 5	1 2	1 3	1 3	1 8	1 2	1 2	1 2	1 3	1 2	1 2	1 1	1 0	0 11
C	0 2¼	0 2	0 1¾	0 1½	0 2	0 1½	0 1½	0 1½	0 2	0 2	0 2	0 1¾	0 1½	0 1½	0 1¼	0 1¼	0 1	0 1
D	0 3	0 2½	0 2½	0 2	0 3	0 2	0 2	0 2	0 4	0 3½	0 3½	0 3	0 3	0 2½	0 2¼			
E	...	...	...	...	...	...	...	...	5 0	4 9	4 9	4 6	4 6	4 3				
F	*wing*	*wing*	*wing*	...	...	...	...	...	*lower*	*lower*	*lower*	*lower*	*lower*	*lower*	*lower*	*lower*	*lower*	*lower*
G	11 0	9 0	7 0															
H	0 10	0 10	0 9	...	...	...	...	...	1 1	1 0	0 11	0 10	0 9	0 8½				
I	1 8	1 8	1 8	*Knee under the Kelson*...............					*eight*	*eight*	*eight*	*eight*	*seven*	*seven*				
K	0 1¼	0 1¼	0 1¼	...	...	...	...	...	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1⅛				
L	16 3	15 10	13 7½	12 2⅞	12 0	...	...	...	18 5	...	18 3	15 3	14 9	16 0				
M	16 9	15 9	14 5	11 9¾	12 9	...	...	...	21 8	...	...	17 0	...	17 6				
N	26 3	25 6	22 3	16 6	22 4	17 6	23 6	19 6	38 3	...	...	30 8	...	27 0	17 0	10 2	20 1	13 3
O	1 2	1 1½	1 0	0 11	1 1	1 2	1 8	1 7	1 4½	1 3½	1 3	1 2	1 1½	1 1	1 0	1 4	0 11	1 0
P	1 5	1 4	1 3	1 1	1 3	1 0	1 0	1 1	1 4	1 3	1 2¾	1 2½	1 2¼	1 2	1 1½	1 1	0 10	0 10
Q	1 4	1 4	1 3	0 11	1 0	1 0	1 0	...	1 4	1 3	1 2¾	1 2½	1 2¼	1 2	1 1½			
R	1 0	0 11½	0 11	0 9½	0 11½	0 8	0 9	0 8	1 3	1 2	1 1	1 0	0 11	0 10¾	0 10	0 9	0 9½	0 7
S	*three*	*three*	*two*	*two*	*two*	*two*	*two*	*two*	*three*	*three*	*three*	*three*	*three*	*two*	*two*	*two*	*two*	*two*
T	3 8	3 6	3 2	3 0	3 6	3 0	3 0	3 2	3 6	3 6	3 6	3 6	3 6	3 4	3 4	3 3	3 0	3 0
V	0 4	0 4	0 3½	0 3	0 3	0 3	0 3	0 3	0 4½	0 4	0 4	0 3½	0 3¼	0 3	0 3	0 2½	0 2½	0 2½
W	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*
X	0 1	0 1	0 0⅞	0 0¾	0 1	0 0¾	0 0¾	0 0¾	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 0¾
Y	0 8½	0 8	0 7½	0 6	0 8	0 8	0 7	0 8½	0 10½	0 10	0 9½	0 9	0 8½	0 8	0 7	0 6½	0 8	0 6½
Z	1 6	1 5	1 3	1 2	1 5	1 1	1 1	1 2	1 4	1 3	1 2¾	1 8	1 7	1 6	1 4	1 3	0 10	1 0
A	1 2	1 2	1 0	1 0	1 2	1 0	1 0	1 0	1 4	1 3	1 2	1 1	1 0	1 0	0 11	0 11	0 11	0 11
B	1 0½	1 0	0 11	0 9½	0 10	0 10	0 10	0 9½	1 3	1 2	1 1½	1 1	1 1	0 11	0 10	0 10½	0 10½	0 9
C	0 11	0 11	0 9	0 7½	0 9	0 10	0 10	0 9	1 1	1 0	0 11	0 10	0 9	0 8½	0 8	0 8½	0 8	0 9
D	*three*	*three*	*three*	*two*	*three*	*two*	*two*	*two*	*five*	*five*	*four*	*three*	*three*	*two*	*two*	*two*	*two*	
E	0 1	0 0⅞	0 0⅞	0 0⅞	0 1	0 0¾	0 0¾	0 0¾	0 1¼	0 1¼	0 1⅛	0 1	0 1	0 0⅞	0 0¾	0 0¾	0 0¾	
F	*four*	*four*	*four*	*three*	*three*	*three*	*three*	*three*	*four*	*four*	*four*	*four*	*four*	*three*	*three*	*three*	*four*	*two*

† The Scarphs are to be tabled together with a Hook-butt, and tarred Flannel is to be laid between the Scarphs. All the Bolts to go through the Apron and well clenched thereon. The Rabbet to be taken out of the middle of the Stem, if required.

‡ The Hawse Pieces to fay against each other in wake of the Holes, and to be open above and below from one to two inches in large ships for air.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
HAWSE PIECES—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Foremost Hawse Piece, sided..................	1 9	1 8½	1 6	1 6	1 6	1 4½	1 4	1 3½	1 3½	1 2	A
Second Hawse Piece, sided......................	1 8	1 7½	1 6	1 5½	1 5	1 4½	1 4	1 3½	} 1 3½	{ 1 2	B
Third Hawse Piece, sided........................	1 8	1 7½	1 6	1 5½	1 5	1 4½	1 4	1 3½		{ 1 2	C
Fourth Hawse Piece, sided......................	1 9	1 8½	1 7	1 6	1 6	1 4½	1 4	1 3½	1 3½	1 2	D
Middle Piece, *when any,* sided, *from 4 to 2 inches less than the diameter of the respective Hawse-holes.*											
Hawse Pieces, sometimes taper at the heels, 2 or 3 inches.											
Holes in diameter, on a square, *after the Pipes are let out*..	1 8	1 6	1 5	1 5	1 4	1 3	1 3	1 2½	1 2½	1 2	E
To be in distance from each other on a square	1 9	1 7	1 6	1 6	1 5	1 3	1 2	1 2	1 1	1 0	F
Hawse Pipes thick at the bottom..................	0 2	0 1¾	0 1½	0 1½	0 1½	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	G
Each to weigh about.................. *cwt. qrs. lb.*	9 0 0	8 3 0	8 2 0	8 0 0	7 0 0	6 0 0	5 0 0	4 0 0	3 0 0	3 1 0	H
The Hawse Pieces bolted together, one bolt above the holes, and *number below*.............	*three*	*three*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	I
The Bolts to be in diameter..........................	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	K
STERN POST.—Fore and Aft at the Head.................	2 2	2 0	1 9	1 8	1 7½	1 7	1 7	1 6½	1 6	1 5½	L
Thwartships at the Head..............................	2 2	2 0	1 9	1 8	1 7½	1 7	1 7	1 6½	1 6	1 5½	M
Fore and Aft at the Wing Transom..............	2 2	2 0	1 9	1 8	1 7½	1 7	1 7	1 6½	1 6	1 5½	N
Thwartships at the Wing Transom................	2 2	2 0	1 9	1 8	1 7½	1 7	1 7	1 6½	1 6	1 5½	O
Fore and Aft at the Deck Transom..............	2 2	2 0	1 9	1 8	1 7½	1 7					
Thwartships at the Deck Transom................	2 2	2 0	1 9	1 8	1 7½	1 7					
Thence to taper at the Keel to......................	1 4	1 4	1 4	1 3	1 2	1 1	1 1	1 1	1 1	1 0	P
Fore and Aft on the Keel *(the back or false post included)*..	3 0	3 0	3 3	3 0	2 9	2 8	2 9	2 7	2 7	2 7	Q
And the main post not to have less wood abaft the rabbet in that direction..........................	1 2	1 1	1 1	1 0	0 11	0 11	0 11	0 11	0 11	0 10	R
Aftside abaft the rabbet at the Wing Transom	1 3	1 2	1 2	1 1	1 0	0 11	0 10	0 10	0 10	0 10	S
Aftside of the rabbet abaft the After-timber expressed in the Dimensions.... { *At Wing Transom, at lower edge of Tuck rail*.......	5 8	6 2	4 1	4 10	8 3	6 8	2 10	4 4	4 0	4 11	T
{ *Upper edge of Keel*.............	4 6	1 10	0 2	1 4	1 4	3 3	0 9½	1 7½	1 6	2 3	U
False Post, the back of it *(if any)* to be abaft the rabbet on the Keel............................	2 4	2 3	2 6	2 3	2 0	2 0	1 10½	1 9	1 9	1 10	W
Bolted to the main Post, with one bolt between each brace, in diameter..........................	0 1⅛	0 1⅛	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	X
INNER POST *—Fore and Aft at the upper end............	1 4	1 3	1 2	1 1	1 0	0 11	0 10½	0 10	0 9½	0 9	Y
Fore and aft on the Keel..............................	1 7	1 6	1 5	1 4	1 3	1 2	1 2	1 2	1 2	1 1	Z
To run up to the under side of Transom.........	*deck*	*deck*	*deck*	*deck*	*deck*	*deck*	*wing*	*wing*	*wing*	*wing*	A
The heel of the Stern Post and Keel to be secured with knee-plates, *in number*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	B
One on each side, the said plates to be broad.......	0 5	0 5	0 4½	0 4½	0 4½	0 4½	0 4	0 4	0 4	0 4	C
Let in flush with thin sheet copper behind. Plates thick..	0 0¾	0 0¾	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0½	0 0½	0 0½	0 0½	D
Arm up the Post long................................	0 3	0 3	2 9	2 9	2 9	2 9	2 6	2 6	2 6	2 6	E
Countersunk Bolt-holes in ditto, *in number*.......	*four*	*four*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	F
Arm along the Keel, *in length*......................	4 0	4 0	3 9	3 9	3 9	3 9	3 6	3 6	3 6	3 6	G
Countersunk Bolts in ditto, *in number*............	*five*	*five*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	H
The Bolts to have proper heads, and in diameter..	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	I
Or the heel of the Post to be secured with dovetail plates, *if preferred*..........................	2 4	2 4	2 0	2 0	2 0	2 0	1 8	1 8	1 8	1 8	K
Broad or spread at the ends..........................	0 8	0 8	0 7	0 7	0 7	0 7	0 6	0 6	0 6	0 6	L
Broad in the middle..................................	0 6	0 6	0 5½	0 5½	0 5½	0 5½	0 5	0 5	0 5	0 5	M
Let in flush with thin sheet copper behind, plates thick..	0 0¾	0 0¾	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0½	0 0½	0 0½	0 0½	N

* Broad, or Thwartships, as the Stern Post from the Lower Transom, upwards, and thence

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	1 1	1 0½	1 0	1 0	1 4	0 10	1 0	0 10½	1 5	1 4	1 3	1 2½	1 2	1 2	1 1	...	...	0 10
B	1 1	1 0½	1 0	1 5½	1 5	0 10	1 0	0 10½	1 5	1 4	1 3	1 1½	1 0½	1 4	1 1	1 1	0 9½	0 9
C	1 1	1 0½	1 0						1 5	1 4	1 3	1 1½	1 0½					
D	1 1	1 0½	1 0	1 0	1 4	0 10	1 0	0 10½	1 5	1 4	1 3	1 2½	1 2	1 2	1 1			
E	1 2	1 1	0 10½	0 10	0 11	0 9	0 9½	0 9	1 3	1 2½	1 2	1 1	1 0½	0 10	0 9	0 8	0 8	0 5
F	1 0	1 0	0 10	0 10	0 10	1 0	0 11	1 2	1 5	1 3	1 1	1 0	1 0	0 11	0 10	0 10	0 10	
G	0 1⅛	0 1	0 0¾	0 0¾	0 1	0 0¾	0 0¾	0 0¾	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 1	0 0¾	0 0¾	0 0¾	
H	3 0 0	2 3 0	2 2 0	2 0 0	2 2 0	1 2 0	1 2 0	1 0 0	4 2 0	4 0 0	3 2 0	3 0 0	2 3 0	2 2 0	1 3 0	1 2 0		
I	*two*	*two*	*two*	*two*	*three*	*one*	*one*	*one*	*two*	*two*	*two*	*two*	*two*	*two*	*one*	*two*	*one*	*one*
K	0 1	0 1	0 0⅞	0 0¾	0 0⅞	0 0¾	0 0¾	0 0¾	0 1¼	0 1⅛	0 1	0 1	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾
L	1 5	1 4	1 2	0 11	1 2	1 1	0 11	1 2	1 5	1 4	1 3½	1 3	0 10	0 10	0 9	0 10	0 10	0 7
M	1 5	1 4	1 2	0 11	1 0	1 1	0 11	1 2	1 5	1 4	1 3½	1 3	0 10	1 1	0 11	0 11	0 11	0 9
N	1 5	1 4	1 4	0 11	1 2	...	...	...	1 5	1 4	1 3½	1 3	1 2	1 2	1 0	0 11	0 11	0 11
O	1 5	1 4	1 3	0 11	1 0	...	...	...	1 5	1 4	1 3½	1 3	1 2	1 1½	1 0	0 10	0 10	0 10
P	0 11	0 10½	0 10	0 8½	0 9½	0 7	0 9	0 7½	1 3	1 2	1 0	0 11	0 10½	0 10	0 9½	0 9	0 9½	0 7
Q	2 6	2 5	2 3	1 8	2 4	2 0	2 9	2 7	2 4	2 3	2 2	2 1	2 0	3 2	2 3	2 9	1 9	1 8
R	0 10	0 10	0 10	0 11	0 11	0 10	0 10	0 10	0 11	0 10	0 10	0 9	0 9	0 8	0 8	0 7	0 8	0 7
S	0 10	0 10	0 9½	0 7	0 9	0 9	0 10	0 10	1 0	0 11	0 11	0 10	0 10	0 11	0 10	0 9	0 9	0 8
T	3 9	3 3	3 0	3 10	4 1½	4 5 *afore it*	4 3 *afore it*	5 0 *afore it*	3 2	2 1½	2 5	3 4	2 4 *afore it*	4 0	4 4 *afore it*	5 0 *afore it*	2 2½ *afore it*	1 3 *afore it*
U	1 1	0 7	0 5½	0 11	1 3	1 3	2 0	2 8	1 1	*well*	0 6	1 8	2 3	0 6	1 3	4 1	0 3	1 4
W	1 9	1 8	1 6	1 3	1 10	1 7½	2 3	2 3	1 6	1 6	1 5	1 4	1 9	2 8	1 8	2 4	1 5	1 4
X	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	0 0¾	0 0¾	0 0⅝	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	0 0⅝	0 0⅝
Y	0 8½	0 8	0 7½	0 7	0 7	0 5	0 6	0 5½	1 0	0 11	0 10½	0 10	0 9	0 8	0 7	0 7	0 7	0 6
Z	1 0	0 11	0 10	0 9	0 11	0 8	0 9	0 9	1 4	1 3	1 2	1 1	1 0	0 11	0 10	0 11	0 9	0 8
A	*wing*	*wing*	*upper filling*	*wing*	*quarter deck*	*wing*	*wing*	*wing*	*wing*	*wing*	*wing*	*wing*	*wing*	*wing*	*wing*	*deck*	*deck*	*deck*
B	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*
C	0 3½	0 3½	0 3	0 3	0 3½	0 3	0 3	0 3	0 4½	0 4	0 4	0 3½	0 3½	0 3½	0 3	0 3	0 2½	0 2½
D	0 0½	0 0½	0 0⅜	0 0⅜	0 0½	0 0⅜	0 0⅜	0 0⅜	0 0⅝	0 0½	0 0½	0 0½	0 0½	0 0½	0 0⅜	0 0½	0 0⅜	0 0⅜
E	2 3	2 3	2 3	2 0	2 3	2 0	2 0	2 0	2 9	2 6	2 6	2 3	2 3	2 0	2 0	2 0	1 6	1 3
F	*three*	*three*	*three*	*two*	*three*	*two*	*two*	*two*	*three*	*three*	*three*	*three*	*three*	*two*	*two*	*two*	*two*	*two*
G	3 3	3 3	3 3	3 0	3 3	3 0	3 0	3 0	3 9	3 6	3 6	3 3	3 3	3 0	3 0	2 9	2 3	2 3
H	*four*	*four*	*four*	*three*	*four*	*three*	*three*	*three*	*four*	*four*	*four*	*four*	*four*	*three*	*three*	*three*	*three*	*three*
I	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0⅞	0 0¾	0 0¾	0 0¾	0 1	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾
K	1 8	1 8	1 6	1 6	1 8	1 6	1 6	1 6	2 0	1 8	1 8	1 8	1 6	1 6	1 6	1 6	1 3	1 3
L	0 6	0 6	0 5½	0 5½	0 6	0 5½	0 5½	0 5½	0 7	0 6	0 6	0 6	0 5½	0 5½	0 5½	0 5½	0 5	0 5
M	0 5	0 5	0 4½	0 4½	0 5	0 4½	0 4½	0 4½	0 5½	0 5	0 5	0 5	0 4½	0 4½	0 4½	0 4½	0 4	0 4
N	0 0½	0 0½	0 0⅜	0 0⅜	0 0½	0 0⅜	0 0⅜	0 0⅜	0 0⅝	0 0½	0 0½	0 0½	0 0½	0 0½	0 0⅜	0 0⅜	0 0⅜	0 0⅜

to the Keel, as the shape of the body may require. To have a tenon into the Keel as the Main Post.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
INNER POST—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Countersunk Bolts in each plate, *in number*......	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	A
The Bolts to have proper heads, and *in diameter*	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	B
TRANSOMS.—WING TRANSOM: Height of the upper side of the Wing Transom at the middle line above the upper edge of the rabbet of the Keel........	30 0	28 6	28 4	26 6	26 0	24 2	22 0	22 1	21 11	20 10	C
Depth of the margin........	0 6	0 6	0 6	0 6	0 5½	0 5½	0 5	0 5	0 5	0 4½	D
Round Aft of the Wing Transom........	0 7	0 6	0 5	0 5	0 6	0 7	0 6	0 6	0 6	0 5½	E
Round down of the Wing Transom at the ends	0 5	0 5	0 6	0 5	0 5	0 4½	0 4	0 4	0 4	0 4	F
Breadth at the Aftside of Wing Transom *, or its length at the Aftside........	36 0	32 3	34 6	32 6	28 9	24 10	28 4	25 0	24 4	24 0	G
Sided........	1 3	1 2½	1 2	1 1½	1 1	1 0½	1 0½	1 0½	1 0½	1 0	H
Moulded at the middle........	2 3	2 2	2 1	2 0	1 11	1 11	1 10	1 10	1 10	1 9	I
Moulded at the ends........	1 9	1 8	1 7	1 6	1 5	1 4½	1 4	1 4	1 4	1 3	K
Bolted to the Post with two Bolts, *in diameter*...	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	L
FILLING TRANSOM, Sided, *or so as to leave for air between*	0 11½	0 11	0 10½	0 10	0 9½	0 9½	0 11	0 11	0 10½	0 10	M
it and the Wing Transom........	0 3	0 2½	0 2	0 2¼	0 3	0 3	0 3	0 3	0 3	0 3	N
And, above the Plank of the Lower Deck........	0 3	0 3	0 3	0 2¼	0 3	0 3	0 3	0 3	0 3	0 2½	O
Bolted to the Posts with two Bolts *(clear of middle) diameter*........	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	P
DECK TRANSOM, Sided........	1 3	1 2	1 2	1 2	1 1	1 0½	1 0	0 11½	0 11½	0 11	Q
Moulded as broad as it possibly can be gotten, and rabbetted on the foreside for the better securing the Deck Plank, if a hook, to be long	...	...	...	...	...	...	...	...	...	...	R
Chocks on the Aftside (if any) *not to exceed in thickness*........	0 9	0 9	0 8	0 7	0 6	0 6	0 5	0 5	0 5	0 4	S
Bolted thro' the Post, with two Bolts *(clear of middle) diameter*........	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1	T
TRANSOMS below the Deck, or FILLING TRANSOMS, *in number*........	*six*	*six*	*six*	*five*	*five*	*four*	*three*	*three*	*two*	*two*	U
Sided — *The First*........	1 1	1 0½	1 0	0 11½	0 11¼	0 10½	0 11	0 10½	0 10½	0 9½	X
Sided — *Second*........	1 1	1 0½	1 0	0 11½	0 11¼	0 10½	0 11	0 10½	0 10½	0 9½	Y
Sided — *Third*........	1 1	1 0½	1 0	0 11½	0 11¼	0 10½	0 11	0 10½	...	...	Z
Sided — *Fourth*........	1 1	1 0½	1 0	0 11½	0 11¼	0 10½	...	...	...	...	A
Sided — *Fifth*........	1 1	1 0½	1 0	0 11½	0 11¼	0 10½	...	...	...	...	B
Sided — *Sixth*........	1 1	1 0½	1 0	0 11	...	...	...	...	...	...	C
Sided — *Seventh*........	1 0	1 0	1 0	...	...	...	...	...	...	...	D
Bolted with one Bolt in each, clear of the Stern Knee Bolt, *diameter*........	0 1½	0 1½	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	E
To leave space for air between each Transom...	0 4	0 3	0 3	0 3	0 3	0 3	0 4	0 4	0 4	0 4	F
The Chocks on the Aftside of the Transoms below the Deck not to exceed in thickness — *Upper*......	1 3	1 2	1 0	1 0	1 0	1 0	0 11	0 10	0 10	0 10	G
The Chocks on the Aftside of the Transoms below the Deck not to exceed in thickness — *Lower*......	1 9	1 7	1 6	1 6	1 5	1 5	1 3	1 2	1 0	1 0	H
WING TRANSOM KNEES.—To have a Knee on each side, *sided if wood* †........	1 2	1 1	1 0½	1 0	0 11¾	0 11½	0 11	0 10½	0 10	0 9½	I
The Fore and Aft arm, in length........	18 0	17 0	16 0	15 0	14 0	13 0	12 6	12 0	11 0	10 0	K
Thwartship arm, in length........	7 6	7 3	7 0	6 9	6 6	6 3	6 0	6 0	6 0	6 0	L
Bolted, with Bolts, in number........	16	16	14	14	12	12	11	11	11	11	M
Bolts in diameter........	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	N
To have two Bolts at each end, or lip, *diameter*	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	O
Iron Wing Transom Knees, each to weigh about *cwt*........	...	...	...	...	...	...	...	...	...	...	P
LOWER DECK TRANSOM KNEES, Sided........	1 0	0 11½	0 11	0 11	0 10½	0 10	0 9½	0 9	0 8½	0 8	Q
Fore and Aft arm to cast under the Beams in length........	10 0	9 6	9 0	9 0	8 9	8 6	8 6	8 6	8 0	7 6	R
Thwartship arm in length, and coak into the Transom........	6 0	5 9	5 6	5 6	5 3	5 0	4 9	4 9	4 9	4 6	S

* No chocks are admitted on the Aftside of the Wing Transom. Observe to place the Bolts clear of the middle. Merchant ships often have the underside wrought straight.

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*four*	*four*
B	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0⅞	0 0¾	0 0¾	0 0¾	0 1	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾
					tuck rail.													
C	19 4	18 6	16 11	12 1	17 3	14 0	18 0	13 0	25 3	23 4	23 4	22 0	18 5½	19 0	14 0	11 3	13 8	8 6
D	0 4½	0 4	0 4	0 3	...	...	...	...	0 5	0 5	0 4½	0 4	0 4	0 3½	...	...	0 3	0 2½
E	0 5	0 5	0 4½	0 4½	...	0 5	0 6	0 5	0 5	0 5	0 5	0 5	0 5½	0 5½	0 5	0 5	0 5	0 3
F	0 4	0 4	0 3	0 3	...	0 3	0 3	0 4	0 4	0 4	0 4	0 4	0 3	0 3	0 3	0 3	0 3	0 2½
G	22 0	19 6	17 1	15 7	9 4	16 6	20 0	15 4	28 4	24 4	23 0	21 0	19 6	17 0	16 2	8 6	17 0	11 10
H	1 0	1 0	0 11	0 9½	...	0 10	0 10½	0 10	1 4	1 3	1 2	1 1	1 0	0 11	0 10	0 9	0 11	0 9
I	1 8	1 6	1 5	1 4	...	1 4	1 3	1 4	1 9	1 8	1 7	1 6	1 5	1 4	1 3	1 0	1 0½	0 8
K	1 3	1 2	1 1	1 0	...	1 0	0 11	1 0	1 6	1 5	1 4	1 3	1 2	1 1	1 0	0 9	0 10½	0 7
L	0 1⅛	0 1⅛	0 1⅛	0 1	...	0 0⅞	0 0⅞	0 0⅞	0 1⅜	0 1¼	0 1⅛	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¼
M	0 9	0 8½																
N	0 2½	0 2½																
O																		
P	0 1	0 1																
Q	0 10½	0 10	...	...	0 9	...	...	...	1 3	1 2	1 1	1 0½	1 0	0 11				
R	...	...	...	...	13 0													
S	0 4	0 4	...	...	*nine*													
T	0 1	0 1	...	...	0 0¾	...	...	...	0 1¼	0 1	0 1	0 1	0 0⅞	0 0⅞				
U	*two*	*two*	*four*	...	...	...	...	...	*seven*	*seven*	*six*	*six*	*five*	*five*	...	...	*four*	*three*
X	0 9	0 9	0 9	...	...	...	...	...	1 1	1 0	0 11	0 10	0 9	0 8	...	...	0 9	0 7
Y	0 9	0 9	0 9	...	...	...	...	...	1 1	1 0	0 11	0 10	0 9	0 8	..	...	0 9	0 6
Z	...	...	0 9	...	...	...	...	...	1 1	1 0	0 11	0 10	0 9	0 8	...	...	0 9	0 6
A	...	...	0 9	...	...	...	...	...	1 1	1 0	0 10	0 9	0 8	0 8	...	...	0 9	
B	...	...	...	...	...	...	...	...	1 1	1 0	0 10	0 9	0 8	0 7				
C	...	...	...	...	...	...	...	...	1 1	0 11	0 10	0 8						
D	...	...	...	...	...	...	...	...	1 0	0 11								
E	0 1⅛	0 1⅛	0 1⅛	...	...	...	...	...	0 1¼	0 1⅛	0 1	0 1	0 0⅞	0 0⅞				
F	0 4	0 4	0 4½	...	...	...	...	...	0 4	0 4	0 4	0 4	0 4	0 4				
G	0 9	0 9	0 8	...	...	...	...	...	0 10	0 9	0 9	0 8	0 8	0 7				
H	0 11	0 10	0 8	...	...	...	...	...	1 0	0 10	0 10	0 9	0 9	0 9				
I	0 9	0 8	0 7	0 6	...	0 5	0 5	0 5	1 0	0 11	0 10	0 9	0 8	0 7	0 6	0 6	0 5½	0 5
K	9 6	8 0	7 0	6 0	...	5 0	5 0	5 0	11 6	10 0	9 0	8 0	7 0	6 0	5 6	5 6	5 0	4 6
L	5 9	5 6	5 0	4 6	...	2 9	2 9	2 9	6 6	6 0	5 9	5 6	5 0	4 6	4 0	4 0	3 6	3 6
M	10	10	10	9	...	7	7	7	9	9	9	9	9	8	7	7	7	7
N	0 1⅛	0 1⅛	0 1	0 0¾	...	0 0¾	0 0¾	0 0¾	0 1⅜	0 1¼	0 1⅛	0 1⅛	0 1	0 0⅞	0 0¾	0 0⅞	0 0¾	0 0¾
O	0 0¾	0 0⅝	0 0⅝	...	...	...	...	...	0 1	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0⅝				
P	...	...	...	...	...	...	...	...	6 2 0	6 1 0	5 0 0	4 2 0	4 0 0	3 2 0				
Q	...	...	...	...	...	...	...	...	0 10½	0 10	0 9	0 8	0 7	0 6½				
R	...	...	...	...	...	...	...	...	8 9	8 6	8 6	7 6	6 6	6 0				
S	...	...	...	...	...	...	...	...	5 3	5 0	4 9	4 6	4 0	3 9				

† The Fore and Aft arm of the Wood Knees are to be coaked or wrought with a Hook and Butt in the upper strake of spirketting, and the Thwartship arm to coak or hook into the Transom Iron Knees. To have iron plates at the toe-holes.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
LOWER DECK TRANSOM KNEES—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Bolted with Bolts *in number*	*twelve*	*twelve*	*ten*	*ten*	*ten*	*ten*	*ten*	*ten*	*ten*	*eight*	A
Middle Deck, *and diameter*	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	1 0⅛	B
Lower deck, or Filling, Transom Knees, if of Iron, to weigh about *cwt*	...	...	...	...	...	...	...	...	...	...	C
Transom Knees between Middle and Lower Deck, or Transom Knees under the Lower Deck, if of Iron; or Pointers under the lower deck; to weigh *cwt.*	...	...	...	...	...	...	...	...	...	...	D
FASHION PIECES.—The After Fashion Piece to be sided	1 1½	1 1	1 0½	1 0½	1 0	0 11½	1 0	1 0	1 0	0 11½	E
After Fashion Piece to run up to the Underside of the	*third*	*third*	*third*	*third*	*filling*	*filling*	*filling*	*filling*	*next to wing*	*wing*	F
Middle Fashion Piece to run up to the Underside of	*deck*	*deck*	*deck*	*deck*							G
And the Heel to the Stepping upon Deadwood *Sided*	1 1	1 1	1 0½	1 0½							H
Foremost Fashion Piece to be Sided, *and to run*	1 2	1 1½	1 1	1 1	1 0½	1 0	1 0½	1 0½	1 0½	1 0	I
up above the Wing Transom, or longer if to be gotten,	3 0	2 9	2 9	2 9	2 6	2 6	2 6	2 6	2 6	2 6	K
and the Heel to run down below the Transoms	1 6	1 3	1 2	1 1	1 0	1 0	1 0	1 0	1 0	1 0	L
The Fashion Pieces to face on upon the ends of the Transoms	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	M
**** The Fashion Pieces and After Timbers are to stand square, or nearly so, with the turn of the body.*											
ROOM and SPACE, or Timber and Room, to be	2 9⅜	2 9½	2 8¾	2 9	2 6	2 9⅜	2 7	2 4⅞	2 5	2 3¾	N
FRAME-TIMBERS.—*The First or Lower, Second or Middle, and Third Futtocks, and Top Timber, to be scarphed or framed together, and bolted with Bolts in each Scarph, in number*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*two*	O
The Bolts to be square iron, *diameter*	0 1½	0 1½	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1	P
Lower Futtocks to be bolted to the Floors in the same manner.											
To have Two Short Timbers over each Port, sided	1 1	1 0½	1 0	0 11	0 10½	0 10	...	...	...	...	Q
and upper end sided	1 0	0 11½	0 11	0 10	0 9½	0 9	...	...	...	...	R
The Short Timber over the Upper Ports to be sided at the *Lower-end*	0 11	0 10½	0 10	0 10	0 9	0 8½	0 8	0 8	0 8	0 8	S
The Short Timber over the Upper Ports to be sided at the *Upper-end*	0 10	0 9½	0 9	0 9	0 8	0 7	0 7	0 7	0 7	0 7	T
FLOOR TIMBERS.—In number	55	53	49	48	47	41	50	46	43	43	V
And sided in the bearing of the ship	1 4	1 3	1 4	1 4	1 3	1 2½	1 2	1 2	1 2	1 1	W
Sided from the bearing of the ship to forward and aft	1 3	1 2	1 3	1 3	1 2	1 1	1 1½	1 1	1 1	1 0½	X
And those quite forward and aft	1 2	1 1	1 2½	1 2	1 1	1 0½	1 0	1 0	0 11½	0 11	Y
Length in the Mid-ships	31 0	29 0	26 0	25 6	25 0	24 0	23 0	22 0	21 0	19 6	Z
Not to have less whole wood below the Cutting down in Mid-ships, and forward and aft to increase with the rising	1 4	1 3	1 4	1 4	1 3	1 2½	1 2	1 2	1 2	1 1	A
*To be moulded at the heads**	1 3	1 2	1 2	1 1½	1 1	1 0½	1 0	0 11½	0 11	0 10	B
LOWER OR FIRST FUTTOCKS.—To be sided along Midships	1 4	1 3½	1 3½	1 3½	1 3	1 2	1 1½	1 1½	1 1½	1 1	C
Ditto afore and abaft	1 3	1 2½	1 2¼	1 2¼	1 2	1 1	1 0½	1 0½	1 0	1 0½	D
To be moulded at the Heads	1 2½	1 2	1 1½	1 1	1 0½	1 0	0 11	0 10¾	0 10½	0 10	E
To scarph on the Second or Middle Futtocks in Mid-ships	8 6	7 9	7 0	7 0	6 6	6 3	6 6	6 6	6 3	6 0	F
Ditto afore and abaft	7 0	6 6	6 9	6 6	5 6	5 3	6 3	6 0	5 6	5 3	G
The Heels of the Futtocks to run down to Deadwood, and to have substance left there	0 7	0 7	0 6	0 6	0 6	0 5	0 5	0 4	0 4	0 4	H
Not to have less stepping or substance at the Heels of the Double Futtocks, and Half Timbers, and	0 4	0 3½	0 3½	0 3½	0 3	0 3	0 3	0 3	0 3	0 2¾	I
the Heels bolted, with bolts, in diameter	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 1	0 0⅞	K

* The Bolts through the Floors are of the same size as the Kelson Bolts. In King's ships the openings are filled up

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
A	...	...	...	...	...	...	...	...	*nine*	*nine*	*nine*	*eight*	*seven*	*seven*				
B	...	...	...	...	...	...	...	...	0 $1\frac{3}{8}$	0 $1\frac{1}{4}$	0 $1\frac{1}{8}$	0 1	0 $0\frac{7}{8}$	0 $0\frac{7}{8}$				
C	...	...	...	...	...	...	...	...	5 0 0	4 1 0	4 0 0	3 2 0	3 0 0	2 1 0				
D	...	...	...	...	...	...	...	...	4 3 0	3 2 0	3 0 0	2 2 0	2 0 17	1 2 9				
E	0 11	0 $10\frac{1}{2}$	0 10	...	...	...	...	...	1 1	1 $0\frac{1}{2}$	0 $11\frac{1}{2}$	0 10	0 $9\frac{1}{2}$	0 8	0 7	0 $7\frac{1}{2}$	0 8	0 7
F	*wing*	*wing*	*next to wing*	...	...	...	...	...	*third*	*third*	*second*	*second*	*second*	*first*				
G																		
H																		
I	0 11	0 $10\frac{1}{2}$	0 10	0 8	...	0 $8\frac{3}{4}$	0 8	0 $8\frac{3}{4}$	1 1	1 $0\frac{1}{2}$	1 0	0 11	0 10	0 $9\frac{1}{2}$				
K	2 6	2 6	2 6	2 0	...	1 10	1 8	1 10	4 0	3 0	2 9	2 9	2 9	2 9				
L	1 6	1 9	2 0															
M	0 1	0 1	0 1	0 $0\frac{3}{4}$	...	...	...	...	0 $1\frac{1}{4}$	0 $1\frac{1}{8}$	0 $1\frac{1}{8}$	0 1	0 1	0 $0\frac{3}{4}$				
N	2 3	2 3	2 4	2 2	2 0	2 0	2 0	2 2	2 $7\frac{1}{2}$	2 6	2 $6\frac{3}{4}$	2 5	2 $2\frac{1}{2}$	2 2	2 0	2 0	2 0	2 $1\frac{3}{16}$
O	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*three*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*
P	0 1	0 1	0 $0\frac{7}{8}$	0 $0\frac{3}{4}$	0 $0\frac{3}{4}$	0 $0\frac{3}{4}$	0 $0\frac{3}{4}$	0 $0\frac{3}{4}$	0 $1\frac{1}{8}$	0 $1\frac{1}{8}$	0 $1\frac{1}{8}$	0 1	0 1	0 $0\frac{7}{8}$	0 $0\frac{3}{4}$	0 $0\frac{3}{4}$	0 $0\frac{3}{4}$	0 $0\frac{3}{4}$
Q	...	...	...	...	...	...	...	...	0 10	0 10	0 9							
R	...	...	...	...	...	...	...	...	0 9	0 9	0 8							
S	0 8	0 $7\frac{1}{2}$	0 $7\frac{1}{2}$	0 7	0 7	...	...	...	0 9	0 8	0 8							
T	0 7	0 $6\frac{1}{2}$	0 $6\frac{1}{2}$	0 6	0 6	...	...	...	0 8	0 7	0 7							
V	41	39	34	31	35	27	36	25	53	50	47	45	40	35	30	26	29	18
W	1 $0\frac{1}{2}$	1 0	0 11	0 10	0 $11\frac{1}{2}$	0 10	0 10	0 $9\frac{3}{4}$	1 $2\frac{1}{2}$	1 2	1 $1\frac{1}{2}$	1 1	1 $0\frac{1}{2}$	1 0	0 $9\frac{1}{2}$	0 8	0 10	0 $9\frac{1}{2}$
X	1 0	0 $11\frac{1}{2}$	0 10	0 9	0 11	0 10	0 10	0 $9\frac{3}{4}$	1 2	1 $1\frac{1}{2}$	1 1	1 $0\frac{1}{2}$	1 0	0 11	0 10	0 $9\frac{1}{2}$	0 $9\frac{1}{2}$	0 8
Y	0 $10\frac{3}{4}$	0 $10\frac{1}{2}$	0 $9\frac{1}{2}$	0 $8\frac{1}{2}$	0 $9\frac{3}{4}$	0 $9\frac{1}{2}$	0 $9\frac{1}{2}$	0 9	1 1	1 0	0 $11\frac{1}{2}$	0 11	0 $10\frac{1}{2}$	0 10	0 9	0 8	0 9	0 7
Z	18 6	17 4	16 4	15 10	17 0	18 8	24 0	16 0	26 0	25 9	25 0	23 9	23 0	19 0	12 0	15 0	16 0	11 0
A	1 $0\frac{1}{2}$	1 0	0 11	0 10	0 $11\frac{1}{2}$	0 10	0 10	0 10	1 $2\frac{1}{4}$	1 2	1 $1\frac{1}{2}$	1 1	1 $0\frac{1}{2}$	1 0	0 $10\frac{1}{2}$	0 10	0 $11\frac{1}{2}$	0 $8\frac{1}{2}$
B	0 $9\frac{1}{2}$	0 9	0 $7\frac{1}{2}$	0 $6\frac{3}{4}$	0 8	0 8	0 $8\frac{1}{2}$	0 9	1 1	1 $0\frac{1}{2}$	0 $11\frac{1}{2}$	0 10	0 9	0 $8\frac{1}{2}$	0 $7\frac{3}{4}$	0 $7\frac{1}{2}$	0 $9\frac{1}{2}$	0 $6\frac{1}{2}$
C	1 1	1 0	0 $10\frac{1}{2}$	0 10	0 $11\frac{1}{2}$	0 $9\frac{1}{2}$	0 10	0 $10\frac{1}{2}$	1 2	1 $1\frac{1}{2}$	1 1	1 $0\frac{1}{2}$	1 0	0 $10\frac{1}{2}$	0 $9\frac{1}{2}$	0 9	0 10	0 $7\frac{1}{2}$
D	1 0	0 11	0 10	0 $8\frac{1}{2}$	0 10	0 9	0 10	0 $10\frac{1}{2}$	1 $1\frac{1}{4}$	1 1	1 0	0 $11\frac{1}{2}$	0 11	0 $9\frac{1}{2}$	0 $8\frac{1}{2}$	0 9	0 $9\frac{1}{2}$	0 $7\frac{1}{2}$
E	0 $9\frac{1}{2}$	0 8	0 7	0 $6\frac{1}{4}$	0 $7\frac{3}{4}$	0 7	0 $7\frac{1}{4}$	0 $7\frac{1}{2}$	1 1	1 $0\frac{1}{2}$	1 0	0 $9\frac{3}{8}$	0 $8\frac{1}{2}$	0 $7\frac{3}{4}$	0 $6\frac{3}{4}$	0 $6\frac{1}{4}$	0 8	0 $5\frac{3}{8}$
F	5 11	5 9	5 6	5 0	5 6	5 0	6 0	5 6	6 10	6 9	6 6	6 0	5 6	5 10	5 0	4 3	4 6	3 6
G	5 0	5 0	5 0	4 8	4 9	4 3	5 0	4 6	6 6	6 3	6 0	5 6	5 0	5 0	4 8	4 0	4 2	3 3
H	0 4	0 4	0 $3\frac{1}{2}$	0 3	0 4	0 3	0 3	0 3										
I	0 $2\frac{1}{2}$	0 $2\frac{1}{2}$	0 $2\frac{1}{4}$	0 2	0 $2\frac{1}{2}$	0 2	0 2	0 2	0 3	0 3	0 3	0 $2\frac{1}{2}$	0 $2\frac{1}{2}$	0 2	0 2	0 $1\frac{1}{2}$	0 $1\frac{1}{2}$	0 $1\frac{1}{2}$
K	0 $0\frac{7}{8}$	0 $0\frac{7}{8}$	0 $0\frac{3}{4}$	0 $0\frac{5}{8}$	0 $0\frac{3}{4}$	0 $0\frac{3}{4}$	0 $0\frac{3}{4}$	0 $0\frac{3}{4}$	0 $1\frac{1}{8}$	0 $1\frac{1}{8}$	0 1	0 $0\frac{7}{8}$	0 $0\frac{7}{8}$	0 $0\frac{3}{4}$	0 $0\frac{5}{8}$	0 $0\frac{3}{4}$	0 $0\frac{3}{4}$	0 $0\frac{3}{4}$

and caulked to the Floor heads. East India ships have four Floors on each side the Main-mast, one inch more sided.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
Lower or First Futtocks—*continued.*	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	
In the Royal Navy, the Woodwanting within side the Heels of the Lower Futtocks is made good up to the cutting down by cross-chocks; but in India, and other merchant ships, the Heels of the Lower Futtocks run no lower than to take a treenail in the outer edge of the Garboard Strake in each timber. To have a Bolt driven from the outside, and clenched upon the Limber Strake through the heel of every Lower Futtock from the After Hatchway to the Foremast. Bolts, in diameter	...	...	...	...	...	...	...	...	...	...	A
Second or Middle Futtocks—Sided along the Midships	1 3½	1 3	1 2	1 2	1 2	1 1½	1 1	1 0¾	1 0½	0 11½	B
D° Afore and Abaft	1 3	1 2½	1 1½	1 1½	1 1½	1 1	1 0½	1 0	1 0	0 11	C
To be moulded at the Heads	1 2	1 1½	1 1¼	1 1	1 0	0 11	0 10½	0 10	0 9¾	0 9	D
To scarph on the Third Futtocks amidships	8 6	7 9	7 0	7 0	6 9	6 6	6 6	6 6	6 3	6 0	E
D° Afore and Abaft	6 6	6 0	6 0	6 0	5 6	5 9	6 0	6 0	5 9	5 3	F
**** The Middle Futtocks that come under the Middle Deck Ports are to run up to the Sills.*											
Third Futtocks.—To be sided along the Midships	1 2¾	1 2¼	1 2	1 2	1 1½	1 0	0 11½	0 11½	0 11½	0 11	G
D° Afore and Abaft	1 2	1 1¾	1 1½	1 1½	1 1	1 0½	0 11	0 11	0 10¾	0 10½	H
To be moulded at the Heads	1 1½	1 1	1 0¾	1 0½	0 11	0 10½	0 10	0 9¾	0 9½	0 8¾	I
To scarph on the Fourth Futtocks or Top-timbers in Midships	8 3	7 9	7 0	7 0	6 9	6 6	6 6	6 6	6 .3	6 0	K
D° Afore and Abaft	6 9	6 3	6 0	6 0	5 9	5 9	6 0	6 0	5 9	5 6	L
**** Those that come under Gun Deck Ports are to run up to the Sills.—In small vessels, where they make the sides of Ports, they must be sided half an inch more, and run up to the topside, and in wake of the Channels.*											
Fourth or Upper Futtocks.—To be sided	1 2	1 1½	1 1½	1 1½	1 1	1 0	0 11½	0 11	0 11	0 10¾	M
To be moulded, at the Middle Deck	1 0	0 11½	...	...	...	...	...	...	...	...	N
D° at the Upper Deck	0 9½	0 9	0 10½	0 10¼	0 10	0 9½	0 9	0 8½	0 8	0 7½	O
To scarph on to the Top-timbers in Midships	12 6	11 9	12 6	12 0	11 9	11 3	11 6	11 0	10 9	10 0	P
D° Afore and Abaft	10 9	10 0	10 0	9 9	8 9	8 0	8 3	8 0	7 9	7 0	Q
**** Upper Futtocks in merchant ships are to run up six inches above the Middle Deck, all Fore and Aft, except those that make the sides of Ports, which are to run up to the top of the side (if to be had). Those under the Ports to run up to the Sills.*											
Top Timbers *.—To be sided at the Heels	1 2	1 1½	1 1	1 1	1 1	1 0	0 11	0 11	0 10¾	0 10½	R
Sided at the Upper Futtock Heads, or in wake of the Ports	1 2	1 1½	1 1	1 1	1 1	1 0	0 11	0 11	0 10¾	0 10½	S
Sided at the top of the side	1 0	0 11½	1 0	1 0	0 11½	0 10½	0 9½	0 10	0 10	0 9½	T
Moulded.—*In the range of the Lower Ports or Upper Deck Ports in Frigates, and at the Middle Deck in Merchant Ships*	1 1	1 0½	1 0	1 0	0 11½	0 10¾	0 9½	0 9	0 8¾	0 8½	U
In the range of the Quarter Deck	0 7	0 7	0 7	0 7	0 6½	0 6½	0 7	0 6½	0 6	0 6	W
In the range of the Forecastle	0 7	0 7	0 7	0 7	0 6½	0 6½	0 7	0 6½	0 6	0 6	X
In the waist at the top of the side	0 6½	0 6½	0 6½	0 6½	0 6	0 6	0 6¾	0 6	0 5½	0 5¼	Y
Counter Timbers. See Stern.											
Kelsons. In number	*one*	*one*	*one*	*one*	*one*	*one*	*one*	*one*	*one*	*one*	Z
Kelsons. To be square (exclusive of what it lets down	1 8	1 7	1 6	1 5	1 4	1 3½	1 3	1 3	1 2½	1 2	A
Between the Floors, which may be	0 1⅜	0 1¼	0 1⅛	0 1	0 1	0 1	0 1	0 1	0 1	0 1	B
Number of Pieces (and give shift to the scarphs of main Keel and Masts	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*five*	C
The scarphs in length (*the middle to come on a floor,*	5 9	5 9	5 6	5 6	5 6	5 3	4 9	4 9	4 9	4 9	D

* Top-timbers making the sides of Ports are sided half an inch more than the above, that they may not be

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	...	...	...	...	...	...	...	...	0 1⅛	0 1	0 0⅞	0 0⅞	0 0⅞	0 0¾				
B	0 11	0 10¾	0 10½	0 8	0 10½	0 9	0 9	0 9	1 1½	1 1	1 0½	0 11	0 10½	0 9¾	0 9	0 8	0 9	0 7
C	0 10½	0 10¼	0 10	0 7½	0 9	0 9	0 9	0 9	1 1	1 0½	1 0	0 10½	0 10	0 9	0 8½	0 8	0 8½	0 7
D	0 8½	0 8	0 6½	0 6	0 7	0 6	0 6½	0 6	1 0	0 11½	0 11	0 8½	0 8	0 7¼	0 6¾	0 6	0 7½	0 5
E	6 0	5 9	5 6	5 0	5 6	5 0	5 3	4 10	6 10	6 9	6 6	6 3	6 0	5 10	5 3	4 9	5 6	4 0
F	5 0	5 0	4 9	4 6	4 6	4 3	4 6	4 0	6 6	6 3	6 0	5 6	5 0	5 0	5 0	4 6	4 9	3 3
G	0 10¾	0 10½	0 10¼	...	0 10													
H	0 10¼	0 9½	0 9½	...	0 9													
I	0 8	0 7½	0 6	...	0 6													
K	6 0	6 0	7 6	...	5 6													
L	5 0	5 0	5 6	...	4 9													
M	0 10½	0 10¼	...	...	...	...	...	...	1 1	1 0½	1 0	0 10	0 9½	0 9	0 8½	0 7	0 8	0 6½
N	...	...	...	...	...	...	...	...	0 11	0 10½	0 10	0 9½	0 9	0 8½				
O	0 7¼	0 7	...	...	...	...	...	...	0 9	0 9	0 8¼	0 8	0 7½	0 7¼	0 7½	0 6	0 7	0 5
P	10 0	10 0	...	...	...	...	...	...	6 10	6 8	6 0	5 0	4 6	6 0				
Q	7 0	6 9	...	...	...	...	...	...	6 6	6 3	5 3	4 9	4 9	4 9				
R	0 10¼	0 10¼	0 10	0 7½	0 11	0 9	0 9	0 8½	1 0½	1 0	0 11	0 10½	0 9½	0 9	0 8	0 7	0 8	0 6½
S	0 10¼	0 10¼	0 10	...	...	...	...	...	1 0½	1 0	0 11	0 10½	0 9	0 9	0 8			
T	0 9½	0 9½	0 10	0 7	0 8	0 7	0 7	0 7	0 11	0 10½	0 10	0 9	0 8	0 7⅜	0 7	0 7	0 7	0 6
U	0 7¾	0 7	0 6	...	0 6¾	...	...	...	0 11	0 10¾	0 10½	0 8	0 7½	0 6¾				
W	0 5¾	0 5½	0 5															
X	0 5¾	0 5½	0 5															
Y	0 5	0 5	0 4½	0 3½	0 5	0 4	0 5½	0 5¼	0 6½	0 6½	0 6½	0 5½	0 5¼	0 4¾	0 4	0 4½	0 5½	0 3½
Z	*one*	*one*	*one*	*one*	*one*	*one*	*one*	*one*	*three*	*three*	*three*	*one*	*one*	*one*	*on*	*one*	*one*	*one*
A	1 1½	1 1	1 0	0 11	1 2	0 11½	1 0	0 11½	1 3½	1 3	1 2½	1 1	1 0½	1 0	0 11	0 10	0 11	0 9
B	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 1	0 0¾	0 0¾	0 0¾	0 1¼	0 1⅛	0 1	0 1	0 1	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾
C	*five*	*fire*	*five*	*three*	*three*	*three*	*three*	*three*	*six*	*fiv e*	*five*	*five*	*five*	*four*	*three*	*three*	*three*	*two*
D	4 6	4 6	4 6	3 10	4 6	4 0	3 9	4 0	4 6	4 6	4 6	4 6	4 0	4 0	3 9	3 9	3 9	3 6

two much weakened by letting in the Sills; and have short Top-timbers to run up to take the rough-tree rail, &c.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
COUNTER TIMBERS—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Lips of the Scarphs not more in thickness than	0 5	0 5	0 5	0 5	0 4½	0 4½	0 4½	0 4½	0 4¼	0 4¼	A
Each Lip to be bolted with two bolts *(two or three inches into the floor) diameter*	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	B
The Kelson to be bolted* through every floor with one bolt, *diameter*	0 1⅞	0 1¾	0 1⅝	0 1½	0 1½	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1¼	C
East India ship's side Kelson to be deep	...	...	...	...	...	...	...	...	...	...	D
broad	...	...	...	...	...	...	...	...	...	...	E
Side Kelsons to be distant from the Midship Kelson, and bolted and fayed upon the Timbers	...	...	...	...	...	...	...	...	...	...	F
Driven upwards with one bolt in two drifts, in every floor and lower futtock heel, *diameter*	...	...	...	...	...	...	...	...	...	...	G
STEMSON, or Inner Stem, to be sided at the upper end,	1 4	1 3	1 2	1 1	1 0½	1 0	0 11½	0 11	0 10½	0 10	H
and moulded	1 4	1 3	1 2	1 1	1 0½	1 0	0 11½	0 11	0 10½	0 10	I
And scarph on to the foremost piece of Kelson	4 9	4 6	4 6	4 6	4 6	4 3	4 0	3 9	3 9	3 9	K
And to run up to the upper side of Deck Transom	*middle*	*middle*	*upper*	*upper*	*upper*	*upper*	*upper*	*upper*	*upper*	*upper*	L
MAIN WALES — Height of the Lower edge — *At the Stem*	25 0	23 6	24 9	22 6	20 9	20 0	20 0	20 3	19 0	19 6	M
At Dead Flat	20 8	19 9	20 0	18 9	17 6	16 6	16 9	16 9	16 6	16 3	N
At the After Timber	25 10½	25 9	25 6	23 9	22 0	21 8	20 6	20 9	20 3	19 6	O
*** *These heights are taken in a line with the upper edge of the rabbet in the Keel.*											
Main Wales broad	5 2	4 8	4 6	4 3	4 2	4 0	3 9	3 9	3 9	3 7	P
Number of Strakes	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	Q
and thickness	0 10	0 9½	0 9	0 8	0 8	0 7	0 6	0 6	0 6	0 5½	R
THICKSTUFF under Main Wales—*Strakes in number*	*eight*	*eight*	*eight*	*eight*	*six*	*six*	*six*	*six*	*six*	*four*	S
The upper edge of the first to be thick	0 8	0 8	0 9	0 8	0 8	0 7	0 6	0 6	0 6	0 5	T
The upper edge of the lower strake, thick	0 6¼	0 6¼	0 5¼	0 5¼	0 5¼	0 5¼	0 4¼	0 4¼	0 4¼	0 4¼	U
*** *The under edge to be of the thickness of the bottom plank, and the intermediate strakes to taper regularly thence to the upper edge of the upper strake.*											
Number of strakes of English plank under the wale	*eleven*	*eleven*	*nine*	*nine*	*nine*	*seven*	*seven*	*seven*	*seven*	*seven*	W
PLANK of the BOTTOM to be thick†	0 5	0 5	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 3	X
And to have three strakes between every two butts, and scarphs in length	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	Y
Number of strakes next the Keel, *to be rabbetted at the butts and edges*	...	...	...	...	...	...	...	..	...	...	Z
To fasten the bottom plank with treenail, size when mooted, (and should not be overhauled afterwards)	0 1¾	0 1¾	0 1¾	0 1¾	0 1⅝	0 1⅝	0 1½	0 1½	0 1½	0 1½	A
To have one bolt in the timber next each butt and clenched inside, *diameter*	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	B
THICKSTUFF upon the Main Wales, strakes, *in number*	*two*	*one*	*two*	*two*	*one*	*one*	*two*	*two*	*two*	*one*	C
The first strake upon the wale....*thick*	0 8	0 7½	0 7	0 7	0 6½	0 5½	0 5	0 5	0 5	0 4½	D
broad	1 1	1 4	1 2	1 1½	1 4	1 3	1 0	0 11	0 11	1 3	E
The second strake upon the wale *thick*	0 7	...	0 6	0 6	...	...	0 4	0 4	0 4	...	F
broad	1 0	...	1 0	1 0	...	...	0 10	0 10	0 10	...	G
Stuff between the Main and Channel Wales, *thick*	0 5	0 4	0 4	0 4	0 4	0 4	...	...	...	...	H
Stuff of Topside, *to diminish from thick stuff upon the wales to under edge of sheer strakes*	...	...	...	...	...	...	0 3	0 3	0 3	0 3	I
CHANNEL WALES—Distance from the upper edge of the Main Wales in Midships to the lower edge of the Channel Wale on a perpendicular	4 4	4 2	4 8	4 5	4 7	4 3					K

* The Kelson Bolts should all be driven through, and carefully clenched on the under side of the Main Keel. Excepting where the rabbet for the plank is taken out in the middle, there they come through and clench on the under side of the Keel that is coaked to the Main Keel.

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigan-tine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	0 4	0 3¾	0 3½	0 3	0 3½	0 3	0 3	0 3	0 4	0 4	0 4	0 3½	0 3½	0 3	0 3	0 2½	0 2	0 2
B	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	0 0⅝	0 0⅝	0 0⅝	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	0 0⅝	0 0⅝
C	0 1¼	0 1¼	0 1¼	0 1	0 1¼	0 0⅞	0 0⅞	0 0⅞	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1⅛	0 1	0 0⅞	0 0¾	0 0¾
D	...	...	...	...	...	...	...	...	1 2	1 1	1 0½							
E	...	...	...	...	...	...	...	...	1 3	1 2	1 1							
F	...	...	...	...	...	...	...	...	2 0	2 0	2 0							
G	...	...	...	...	...	...	...	...	0 1⅜ 0 1¼	0 1⅜ 0 1¼	0 1¼ 0 1⅛							
H	0 9	0 9	0 8½	0 7	0 8	0 7	0 7	0 6¾	1 0	0 11½	0 11	0 10	0 9	0 8½	0 8	0 8	0 10	
I	0 9½	0 9	0 8½	0 7	0 8	0 7	0 7	0 6¾	0 10	0 9½	0 9	0 9	0 8	0 7	0 6½	0 6½	0 8	
K	3 6	3 6	3 0	2 9	3 0	2 9	2 9	2 9	4 6	4 6	3 9	3 6	3 6	3 0	3 0	3 0	2 9	
L	*upper*	*upper*	*upper*	*upper*	*upper*	*upper*	*upper*	*upper*	*middle*	*middle*	*middle*	*upper*	*upper*	*upper*	*upper*	*upper*	*upper*	
M	17 0	16 3	14 6	10 9	13 8	11 9	16 8	12 10	22 6	21 6	19 3	17 9	17 8	16 10	11 6	8 7	11 9	7 3
N	14 3	13 6	12 10	8 10	10 10	9 6	12 9	10 3	20 0	18 2	17 9	15 8	15 4	13 3	9 6	7 9	9 9½	5 11
O	17 3	17 0	15 3	11 6	13 8	13 0	17 0	11 10	22 6	21 6	21 0	19 6	17 11	17 0	12 9	10 9	12 6	7 8
P	3 6	3 3	2 8	1 8	2 6	1 6	2 0	2 0	5 0	5 0	5 0	3 4	3 4	3 4	1 8	1 8	2 0	1 4
Q	*four*	*four*	*three*	*two*	*three*	*two*	*two*	*two*	*six*	*six*	*six*	*four*	*four*	*four*	*two*	*one*	*three*	*two*
R	0 5	0 5	0 4½	0 4	0 5½	0 4	0 4	0 4	0 7	0 7	0 6	0 6	0 5	0 4½	0 4	0 4	0 5	0 4
S	*three*	*three*	*two*	*two*	*three*	*one*	*one*	*two*	*six*	*six*	*four*	*four*	*three*	*three*	*two*	*two*	*two*	*two*
T	0 5	0 5	0 4	0 3	0 5	0 3	0 3	0 3	0 6	0 6	0 5	0 5	0 4	0 4	0 3	0 3	0 3	0 3
U	0 3¼	0 3¼	0 3¼	0 2¾	0 3¼	0 2¾	0 2¾	0 2¾	0 5¼	0 5¼	0 4½	0 4¼	0 3¼	0 3¼	0 2¾	0 2¼	0 2¼	0 2¼
W	*six*	*six*	*five*	*four*	*five*	*five*	*five*	*five*	*nine*	*nine*	*nine*	*eight*	*eight*	*seven*	*six*	*six*	*five*	*four*
X	0 3	0 3	0 3	0 2½	0 3	0 2½	0 3	0 2½	0 5	0 4	0 4	0 4	0 3	0 3	0 2½	0 2	0 2½	0 2
Y	6 0	6 0	6 0	5 6	6 0	5 6	5 6	5 6	6 0	6 0	6 0	6 0	5 6	5 0	5 0			
Z	...	...	...	...	...	...	...	...	*four*	*four*	*four*							
A	0 1⅜	0 1⅛	0 1¼	0 1⅛	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1¾	0 1⅝	0 1½	0 1⅜	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 1
B	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0⅞	0 0¾	0 0¾	0 0¾	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	0 0⅝
C	*one*	*one*	*one*	*one*	*one*	*one*	*one*	*one*	*two*	*two*	*two*	*two*	*two*	*two*	*one*	*one*	*one*	*one*
D	0 4	0 4	0 3½	0 3	0 4	0 3	0 3	0 3	0 5½	0 5½	0 5	0 5	0 4	0 3½	0 3	0 3	0 3½	0 3
E	1 2	1 1	0 10	0 10	0 10	0 9	0 11	0 10	1 1	1 0½	1 0	0 11	0 11	0 11	0 10	0 9	0 9	0 8
F	...	...	...	...	0 3	...	...	...	0 4	0 4	0 4	0 4	0 4	0 3				
G	...	...	...	...	0 9	...	...	...	0 11	0 11	0 11	0 10	0 10	0 10				
H	...	...	...	...	...	...	...	...	0 4	0 4	0 4							
I	0 2½	0 2½	0 2	0 2	0 2½	0 2	0 2	0 2	0 4	0 4	0 4	0 3	0 3	0 2½	0 2	0 2	0 2	0 1½
K																		

† Owing to the scarcity of Oak plank, it is admitted, particularly in merchant ships, to work 2½ and 3-inch plank, with six feet shift, and two strakes between; and 4-inch plank, and upwards, with five feet shift, and three between every two butts upon the same timber.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
CHANNEL WALES—*continued.*											
Channel Wale broad	3 0	3 5	3 0	3 0	2 6	2 4					
Number of Strakes	*three*	*three*	*three*	*three*	*two*	*two*					
Thickness	0 6	0 5½	0 5½	0 5	0 5	0 5					
*** *The lower edge of the Channel Wales should work down to the Stops of the Ports below, Wood being left sufficient for the Port Hooks.*											
Plank above the Channel Wales.—*The lower edge of the first Strake upon the Channel Wales to be thick*	0 5	0 4½	0 4	0 4	0 4	0 3½					
The second Strake above to be thick	0 4	0 4	0 3	0 3	0 3	0 3					
SHEER WALES.—Distance from the upper edge of the Channel Wales to the lower edge of the Sheer Wales on a perpendicular	4 0	3 5									
Sheer Wales broad	2 9	3 2									
Number of Strakes	*three*	*three*									
Thickness	0 4	0 4									
*** *The lower edge of the Sheer Wales should work down to the Stops of the Middle Deck Ports, and sufficient Wood left for the Port Hooks.*											
SHEER STRAKES.—Distance on a perpendicular from the upper edge of the Sheer Wales (in three-deck ships) of Channel Wales (in two-deck ships) and main Wales (in Frigates, &c. &c.) to the Top-timber line or upperside of the Sheer Strakes	5 7	4 4	5 4	5 4	4 1	4 9	...	6 9	6 9	6 0	A
Sheer Strakes broad	1 8	1 1	1 10	2 2	1 0	1 1	...	1 11	1 11	1 10	B
Number of Strakes	*two*	*one*	*two*	*two*	*one*	*one*	*two*	*two*	*two*	*two*	C
and thick	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	D
*** *The lower edge of the Sheer Strakes works down to the Ports of the Upper Deck along the Midships—To be of English Oak Plank behind the Channels.—The Sheer Strakes to be kept parallel Fore and Aft.*											
Plank upon the first drift to be thick	0 3	0 3	0 3	0 3	0 3	0 2½	0 2½	0 2½	0 2½	0 2½	E
Plank next under the Plank Sheers, upper edge thick	0 2½	0 2½	0 2½	0 2½	0 2	0 2	0 2	0 2	0 2	0 2	F
BUTT END BOLTS.—To have one Bolt driven with a ring under its head (or a full head made) in the timber next the butt of the Wales. Clamps, and all stuff, 4 inches thick: the bolts the size of those in the butts of the bottom.											
WITHIN BOARD.											
ORLOP CLAMPS; Strakes in number	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	
The upper Strake *thick*	0 9	0 8	0 7	0 7	0 7	0 6	0 5	0 5	0 5	0 4	
broad	1 4	1 4	1 3	1 3	1 2	1 2	1 2	1 1	1 1	1 1	
The lower Strake *thick*	0 8	0 7	0 6	0 6	0 6	0 5	0 4	0 4	0 4	0 3	
broad	1 2	1 2	1 1	1 1	1 1	1 0	0 11	0 11	0 11	0 11	
The said two Strakes may be reduced to one at the fashion piece and apron, and reduced in thickness within 7 or 9 feet to	0 6	0 5	0 5	0 5	0 5	0 4	0 3	0 3	0 3	0 2½	
and broad	1 0	0 11	0 10	0 10	0 10	0 10	0 10	0 10	0 10	0 9	
ORLOP BEAMS.—The upper sides to be below the under side of the gun-deck plank at the middle of the beam *Afore*	7 3	7 1	7 2	7 2	6 10	6 9					
Midships	7 1	7 1	7 0	7 2	6 10	6 9	5 2	5 2	5 2	5 0	
Abaft	7 3	7 1	7 2	7 2	6 10	6 9					
Beams to round up in Midships	0 2	0 2	0 2½	0 2½	0 2	0 2	0 2	0 2	0 2	0 2	
To have beams in number	20	20	24	22	21	21	*six*	*six*	*six*	*six*	
Aftside of the after beam afore the after perpendicular	25 0	23 0	22 6	24 3	22 9	19 0					

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	6 6	6 4	...	3 11	4 3	4 4	3 9	4 4										
B	1 10	1 8	1 8	0 10	0 10	0 11	0 11	0 10										
C	*two*	*two*	*two*	*one*	*one*	*one*	*one*	*one*										
D	0 3½	0 3½	0 3	0 2½	0 3	0 2½	0 2½	0 2½										
E	0 2½	0 2½	0 2	0 1½	0 2	...	...	...	0 3	0 3	0 3	0 2½	0 2	0 2				
F	0 2	0 2	0 1½	0 1½	0 2	...	...	...	0 3	0 3	0 3	0 2	0 2	0 2				

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
Orlop—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Fore-side of the foremost Beam abaft the foremost perpendicular	10 0	9 9	11 3	10 3	8 0	8 0					
Orlop beams to be square *(from the beam to which the After Riding Bitts are bolted to the beam that makes the forepart of Cockpit*	1 5	1 4	1 3½	1 3	1 2	1 1	0 11	0 10½	0 10	0 10	
Fourth beam from aft	1 4	1 3	1 2¾	1 2	1 2	1 1					
Third beam from aft	1 3	1 2½	1 2	1 1½	1 1½	1 0½					
Second beam from aft	1 2	1 1½	1 1	1 1	1 0½	1 0					
After beam	1 1	1 1	1 0½	1 0½	1 0	0 11					
Fourth beam from forward	1 4	1 3	1 3	1 3	1 2	1 1					
Third beam from forward	1 3	1 2½	1 2½	1 2½	1 1½	1 0½					
Second beam from forward	1 2	1 2	1 2	1 2	1 1	1 0					
Foremost beam	1 1	1 1	1 0½	1 0½	1 0	0 11					
*** *Those Beams which are made in two or more pieces are put together and bolted as the Gun-deck beams, which see.*											
Knees—*The Orlop beams to be kneed at each end, with one Lodging Knee, fayed home to the Timbers, excepting to those beams that come upon the inside stuff, there the Knees to fay also.*											
Lodging Knees—to be sided	0 10½	0 10	0 9½	0 9¼	0 9	0 8½	0 8	0 7¾	0 7½	0 7¼	
Thwartship Arm long *(coak into the beam)*	4 9	4 8	4 7	4 6	4 4	4 2	4 0	3 9	3 7	3 6	
Fore & Aft Arm from beam to beam, or not short of	4 9	4 8	4 7	4 6	4 4	4 2	4 0	4 0	4 0	4 0	
Standard Knees, to have one Standard Knee to each end of every beam, except those beams where there comes second futtock riders and the beams from afore and abaft	*three*	*three*	*three*	*three*	*two*	*two*					
Standard Knees to be sided	0 11	0 10½	0 10	0 9½	0 9½	0 9	0 8½	0 8	0 8	0 8½	
Thwartship Arms long	4 6	4 5	4 4	4 3	4 2	4 0	3 10	3 9	3 7	3 3	
The side arms to reach upwards from the underside of the Orlop beams to the underside of the Gun-deck beams within two inches.											
The Knees to be bolted with *bolts, in number*	*nine*	*nine*	8 *or* 9	8 *or* 9	8 *or* 9	8 *or* 9	8 *or* 9	8 *or* 9	8 *or* 9	8 *or* 9	
in diameter	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	
*** *To have four bolts in the beam arms and five bolts in the side arms where the length will admit.*											
Carling—To frame the Orlop on each side, *No. of tiers,*	*four*	*four*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	
From the room before the Fore Hatchway to the room of the Mizen-mast, and from thence forward and aft *tiers*	*three*	*three*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	
Carlings *broad*	0 11	0 10½	0 10	0 9	0 8½	0 8	0 7½	0 7	0 7	0 6½	
Carlings *deep*	0 10	0 9½	0 9	0 8	0 7½	0 7	0 6½	0 6	0 6	0 5½	
—— scored on upon the beams aloft	0 1½	0 1½	0 1½	0 1½	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	
and below	0 1¼	0 1¼	0 1¼	0 1¼	0 1	0 1	0 1	0 1	0 1	0 1	A
The side tier of Carlings to be kept out clear of the side	3 9	3 7	3 6	3 6	3 6	3 6	3 4	3 4	3 4	3 4	
Ledges.—The Ledges to be *broad*	0 6	0 6	0 5½	0 5½	0 5½	0 5	0 5	0 5	0 5	0 4½	
deep	0 5	0 5	0 5	0 5	0 5	0 4½	0 4½	0 4½	0 4½	0 4	
asunder	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	
Plank or Board, for the Orlop flat, *thick*	0 2	0 2	0 2	0 2	0 2	0 1½	0 1½	0 1½	0 1½	0 1½	B
Strake upon the ends of the Orlop beams *thick*	0 8	0 7½	0 7	0 6	0 5½	0 5	0 5	0 4	0 4	0 4	
and *broad*	1 3	1 2	1 2	1 2	1 1	1 1	1 1	1 0	1 0	1 0	C
Plank above this strake to the Gun-deck clamps to be *thick*	0 6	0 5	0 4½	0 4½	0 4	0 4	0 3½	0 3	0 3	0 3	
Step for the Fore Jear-capstan, *broad*	2 0	1 11	1 10	1 10	1 9	1 9					
Depth to answer with the Capstan-partners aloft.											
To be let down with a double stop, and on the beam aloft	0 2½	0 2¼	0 2⅛	0 2⅛	0 2	0 2					
And the ends to be bolted through the beams with two bolts in diameter	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	...	...	...	...	D

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60

A Of those carlings that make the sides of hatchways, and the tier next the side, and also the carlings in the fore platform and after platform, the upper sides are to be kept flush with the upper sides of the beams; the other carlings are to be let down below the upper side of the beams, the thickness of the flat, and sometimes one inch more.

B And let on to rabbets taken out of the beams, and those carlings which are even with the upper sides of the beams.

C And let down upon the ends of the beams $1\frac{1}{2}$ inch.

D And to be in length the whole distance from the aftside of the after beam to the foreside of the foremost beam.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	
Sail Room.—To have one in Midships abaft the Fore Hatch, and extend to the main Hatch, the Capstan being parted off; built with 1¼ inch rabbetted deals upon Carlings. The said Carlings to be *deep*	1 0	1 0	1 0	1 0	1 0	0 11	…	…	…	…	A
and *broad*	0 10	0 10	0 10	0 10	0 10	0 9	…	…	…	…	B
The Stantions of the Sail Room to be *square*	0 8	0 8	0 7	0 7	0 7	0 7	…	…	…	…	C
Stantions.—To have a tier next the side, and at each end of the Orlop, to stop the crowns of the cables, *sided*	0 8	0 8	0 8	0 8	0 7½	0 7	0 7	0 7	0 6½	0 6½	D
To be Fore and Aft	0 7	0 7	0 7	0 7	0 6½	0 6	0 6	0 6	0 6	0 6	E
The said Stantions to be kept clear of the side	3 9	3 7	3 6	3 6	3 6	3 6	3 4	3 4	3 4	3 4	F
*** *The Flat within the Wings to be framed with ledges 3 inches square, let down into the side Carlings and Knees.*											
Dunnage Battens between the said Stantions. *To have oak battens about 4 or 5 inches broad, and two inches deep, nailed down on*											G
Hammock Racks and Tricing. *The same as on the Gun Deck, to be fixed overhead in the cable tiers.*											
Hatchways.—To be framed with plank of	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	
broad	0 8	0 8	0 8	0 8	0 7	0 7	0 6	0 6	0 6	0 6	
bearded to the edge to	0 2	0 2	0 2	0 2	0 2	0 2	0 1½	0 1½	0 1½	0 1½	
Platform Beams, *sided*	…	…	…	…	…	…	0 10½	0 10½	0 10	0 9½	H
moulded	…	…	…	…	…	…	0 10	0 10	0 9½	0 9	I
asunder about	…	…	…	…	…	…	2 9	*to*	3 9	3 9	K
to round up	…	…	…	…	…	…	0 2	0 2	0 2	0 2	L
Height from the upper side of the Flat, *at the middle line*, to the under side of the Deck Plank above, of the Fore Platform	…	…	…	…	…	…	6 3	6 3	6 3	6 3	M
Ditto of the After Platform	…	…	…	…	…	…	6 3	6 3	6 3	6 3	N
Knees.—The Platform Beams to knee at each end, with two Lodging Knees, or one Lodging Knee, and one hanging Standard. *(The hanging Standards are mostly to the after beam and fourth beam from aft.)*											
Hanging Standard, *sided*	…	…	…	…	…	…	0 8	0 7½	0 7½	0 7	
Lodging Knees, *sided*	…	…	…	…	…	…	0 7	0 7	0 7	0 6	O
Hanging Arm of the Standard, *long*	…	…	…	…	…	…	6 0	6 0	5 10	5 9	
Standards and Lodging Knees, Thwartship Arms, *long*	…	…	…	…	…	…	3 9	3 8	3 7	3 6	P
Bolted with Bolts, *in number*	…	…	…	…	…	…	*nine*	*eight*	*eight*	*seven*	Q
diameter	…	…	…	…	…	…	0 1⅛	0 1⅛	0 1⅛	0 1	R
Framing upon the Fore Platform.—*To have a scuttle between the first and second beam from forward: to go down into the fore peek, fitted with light gratings or hatches. The said scuttle to be on the starboard sde of the middle line, to be athwart ships*	2 9	2 6	2 6	2 6	2 6	2 6					
Fore and aft abaft the foremost beam in the clear	3 6	3 3	3 0	3 0	3 0	3 0					
Scuttle to light room upon the larboard side, close abaft the second beam from forward, *To be square in the clear*	3 0	2 10	2 9	2 9	2 7	2 7					
Scuttle to magazine, upon the starboard side, close abaft the fourth beam from forward, *To be square in the clear*	3 0	2 10	2 9	2 9	2 7	2 7					
A cap scuttle upon the larboard side, abreast the magazine scuttle: to hand up filled cartridges, *To be square in the clear*	1 6	1 6	1 6	1 6	1 4	1 3					
A flat scuttle in the Midships between the after riding bitts.—To the fore shot locker or coal hole. *Fore and Aft*	2 6	2 6	2 4	2 4	2 2	2 2					
Thwartships	3 0	3 0	2 9	2 9	2 9	2 9					

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	The Carlings are to be let down in the Orlop beams 1¼ inch, and the upper sides rabbeted 1½ inch.																	
B	Down to 1½ inch of the insides. Upon the upper sides of the Carlings are fixed the Stantions.																	
C	The Heels to be chased into the Carling, and the Heads tenoned up into the beams, allowing the thickness of the deal without the rabbet. The outsides of the Stantions to be rounded with a bold round. About 1 ft. 3 in. from the sides of the Sail Room, in the clear, are fixed another tier of Stantions of the same size, and rounded on the side-side opposite those for the Sail Room.																	
D E F	The sides next the cables to be rounded, and to have rabbets formed on the insides, with quartering brought on sideways to receive pannels of lattice work between, to form the wings, made of 1¼ inch deal, and bolted into the sides.																	
G	*the Flat about 2 feet asunder, and the upper edges champhered.*																	
H	0 9	0 8	0 6½	0 6	0 7	0 6	0 6	0 5½										
I	0 8	0 7	0 5½	0 5	0 6	0 5	0 5	0 4½										
K	3 9	3 9	3 9	3 9	3 9	3 9	3 9	4 0										
L	0 1½	0 1½	0 1	0 1	0 1	0 1	0 1	0 1										
M	6 2	6 0	4 9	6 1	6 2	5 3	6 0	5 7										
N	6 2	6 0	4 9	...	6 3	6 3	6 0	6 1										
O	0 6	0 5½	0 5	If required.														
P	3 3	3 3	3 0															
Q	*six*	*six*	*six*															
R	0 1	0 0⅞	0 0⅞															

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
Framing of Platforms—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Framing upon the After Platform.—To have a double flap scuttle, with a fore and aft carling in the midships, to shift with rabbets, and the flaps hung next the side with hinges.											
To Spirit Room to be { *Fore and Aft*............	4 9	4 9	4 9	4 9	4 9	4 9	4 9	4 9	4 9	4 9	A
{ *Thwartships*..............	7 0	7 0	7 0	7 0	7 0	6 9	6 0	6 0	6 0	5 9	B
To have a double flap scuttle over the fish room, (now used for spirits or coals) fitted as the spirit room scuttle in large ships, but a single flap in Frigates, &c.											
Fish-room scuttle to be { *Fore and aft*...........	3 9	3 9	3 9	3 9	3 9	3 9	3 6	3 6	3 6	3 6	C
{ *Thwartships*............	4 9	4 9	4 9	4 9	4 9	4 9	4 9	4 9	4 9	4 9	D
Carlings* to have tiers of carlings *in number*.....	...	...	...	...	...	...	*three*	*three*	*three*	*three*	E
broad...	...	...	...	...	...	...	0 6	0 6	0 6	0 5	F
deep....	...	...	...	...	...	...	0 5	0 5	0 5	0 4	G
Ledges.—The Platform Ledges to be asunder.............	...	...	...	...	...	...	1 0	1 0	1 0	1 0	H
broad...	...	...	...	...	...	...	0 4	0 4	0 4	0 3½	I
deep....	...	...	...	...	...	...	0 3	0 3	0 3	0 3	K
Bulkheads and Store-rooms upon the Platforms. To build a Bulkhead on each side with 1¼ inch rabbetted deal, and Stantions the side sufficiently only to take up the wing-scuttles, and to have a hanging or sliding door at each end.											L
To the midships of the wing bulkhead on the larboard side to build a sail-room forward, a boatswain's store-room annexed,											M
Sail room in length about	21 0	21 0	20 0	20 0	18 0	16 0					
The ship's side in the sail-room to be lined with feather edged deal. N. B. The stantions to stand on the foreside of the sail room bulk-head on account of the sliding scuttle out of the boatswain's store-room.											
The bottom of the sail-room dunnaged with battens.......................................*square*	0 2	0 2	0 2	0 2	0 2	0 2					
Boatswain's store-room, in length about...........	15 0	15 0	14 0	14 0	12 0	11 0	...	...	...	...	N
Boatswain's cabin, or block-room,.......*length*...	6 0	6 0	6 0	6 0	6 0	6 0	...	...	...	...	O
To the midships of the wing bulkhead on the starboard side, to build a carpenter's store-room; and abaft it, a carpenter's cabin, or pitch room.											
Carpenter's store-room in length about...........	27 0	26 0	25 0	24 0	23 0	22 0	...	...	...	...	P
Carpenter's cabin, or pitch-room in length	6 0	6 0	6 0	6 0	6 0	6 0	...	...	...	...	Q
To build upon the starboard side a passage to the magazine scuttle, of 1½ inch rabbeted deals. The said passage to be lined with plaster, and slit deal on each side.											
Passage to magazine in the clear....................	3 0	3 0	2 9	2 9	2 6	2 6	...	...	...	...	R
The sills of the doors to be deep.........	1 0	1 0	1 0	1 0	0 11	0 11					
And the passage lined with lead on the flat, 7lbs. to the foot square, turned up at the sides five or six inches, and the corners care-											S
To build on the larboard side a passage to the light-room scuttle, and to inclose the scuttle for handing up filled cartridges with											T
To build a gunner's store-room, at the foreside of the foremost beam, by 1¼ inch deal bulkhead athwart ships. The inside to be											V
The gunner's passage to the store-room is between the magazine and light-room passages.											
To build a grating, or lattice bulkhead, with a door on the starboard side, at the aftside of the platform. N. B. The stantions											W
After platform to the midships of the wing bulkhead, on the larboard side, to build abaft a steward's room next afore. A cabin for											X
Stewards room to be in *length*.....................	10 0	10 0	9 0	9 0	8 0	7 0	...	...	...	...	Y
fore bulkhead for a dresser, and a shelf above it. The fore bulkhead to be double tinned down to the dresser, and over											Z
Cabin for the purser, in length.....................	6 0	6 0	6 0	6 0	6 0	6 0	...	...	...	...	A
Store-room for marine clothing, in length	6 9	6 9	6 0	6 0	5 6	5 0	...	...	...	...	B
Slop-room, to be in length..........................	5 6	5 6	5 0	5 0	4 0	4 0	...	...	...	...	C
To the midship of the wing bulkhead, on the starboard side, to build a store-room for the captain abaft, next afore that a cabin for the surgeon, and before that a store-room for the first lieutenant.											

* The side tier of carlings in large ships are to be kept at a sufficient distance from the side on the fore platform, for scuttles in the

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	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 339	TONS 201	TONS 130	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	4 9	4 9	4 6	...	3 0													
B	5 3	5 0	4 9	...	4 9													
C	3 4	3 4	3 0															
D	4 9	4 9	4 6															
E	*three*	*three*	*three*	...	*three*													
F	0 5	0 5	0 4	...	0 4													
G	0 4	0 4	0 3	...	0 3													
H	1 0	1 0	1 0	...	1 0													
I	0 3	0 3	0 3	...	0 3													
K	0 2½	0 2½	0 2	...	0 2													

L about 3½ by 4½ inches the whole length of the platforms, and sometimes round the forepart. The said Bulkhead to be kept from

M and abaft the store-room a boatswain's cabin, or block-room.

N Fitted with bins, shelves, and a fixed light.
O Cabins fitted with bed-place, sash-light, lockers, cupboard, and shelves.

P Fitted with a nail-room, bins, shelves, and a fixt light.
Q Fitted as the boatswains. All ships under the rank of line of battle ships have the officers cabins built upon the lower deck.

R To have two doors near the entrance of the passage for the better security.

S *fully turned so as to hold water when required.*
T *a door; and line the same with slit deal and plaster.*
V *fitted with bin, shelves, and racks with pins.*

W *to be on the foreside of the bulkhead.*
X *the purser before that, a marine clothing room, and afore that a slop room.*
Y Fitted with a bin at the side, and sliding door into the bread room, and an elm plank about 20 inches wide fitted against the
Z head as far aft as the aft part of the door way, which is to be hung in two, that the upper half only may be used occasionally.
A Fitted as the cabins forward.
B Fitted with a bin next the side, and shelves all round.
C Fitted with a bin next the side, and lockers and shelves all round.

wings, through which persons may go down in time of action: and, to secure thereto the heads of the wing-stantions in the magazine.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
BULKHEADS and STORE-ROOMS—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
The Captain's store-room to be in length about	13 0	12 0	11 0	10 0	10 0	10 0	...	...	...	...	A
To drive two eye-bolts in the aftside of the beam next abaft the foremost bulkhead, to sling a wine cask. The doors to be double, and shut against a shifting Stantion, that one or both may be used occasionally.											
Surgeon's cabin to be in length	6 0	6 0	6 0	6 0	6 0	6 0	...	...	...	...	B
Lieutenant's store-room to be in length about...	6 9	6 9	5 9	5 9	5 0	4 9	...	...	...	...	C
Lastly, to complete the Cockpit, by building a bulkhead athwart, close abaft the Steward and Captain's store-room doors. On the											D
Steward, on the larboard side of the light-room door. Or, in smaller ships, a Dispensary over the crowning of the powder-room.											E
MIDSHIP PLATFORM between the main and fore Hatchways.											
Beams, *sided*..................	...	...	...	...	...	...	0 11	0 10	0 10	0 10	F
moulded...............	...	...	...	...	...	...	0 10	0 10	0 10	0 9	G
round up	...	...	...	...	...	...	0 2	0 2	0 2	0 2	H
KNEES.—The Beams to be knee'd at each end with two Lodging Knees, sided	...	...	...	...	...	...	0 7	0 7	0 7	0 7	
Every other Beam to have a hanging Standard, sided..	...	...	...	...	...	...	0 8	0 8	0 7½	0 7½	I
Length of Arms, and bolting the same as the Platforms. *To have also a grating or lattice bulkhead at the fore end, and after*											K
IN THE HOLD.											
LIMBER BOARDS to be thick (of English oak plank) and fitted into rabbets to lie flush	0 3½	0 3½	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	L
Strake next the Limbers, or upon the lower Futtock Heels, *out from the side of the Kelson*	0 11	0 11	0 11	0 11	0 11	0 11	0 11	0 11	0 11	0 11	M
The Limber boards not to exceed 3 feet long, and those under the hatchways to be fitted with the grain upwards.											
Number of thick Strakes next the Limbers......	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	N
The first *thick* or Limber Strake......	0 8	0 8	0 8	0 8	0 7	0 7	0 6	0 6	0 6	0 5½	O
broad............................	1 3	1 3	1 2	1 2	1 2	1 1	2 0	1 11	1 11	1 10	P
The second to be *thick*............	0 7	0 7	0 7	0 7	0 6	0 6	Wrought Top and Butt.				Q
broad...........	1 2	1 2	1 1	1 1	1 1	1 0					R
If not Three Kelsons } The third to be *thick*............	...	...	...	...	...	...	...	...	...	...	S
broad...........	...	...	...	...	...	...	...	...	...	...	T
Which Strakes may be reduced to one afore and abaft, and in thickness (within about 9 feet of the extreme)............................	0 6	0 6	0 5½	0 5½	0 5	0 5	0 4	0 4	0 4	0 3	U
THICKSTUFF at the FLOOR-HEADS, *number of Strakes*...	*five*	*five*	*five*	*five*	*five*	*five*	*six*	*six*	*six*	*six*	X
The middle Strakes, or Strake, that is wrought on the joints of the floor-head, to be } *thick*...	0 9	0 9	0 8	0 8	0 7½	0 7	0 7	0 6	0 6	0 5½	Y
broad...	1 6	1 5	1 4	1 3	1 3	1 2	1 2	1 11	1 10	1 9	Z
And the Strake, or Strakes, above and below those on the joints, to be..... } *thick*...	0 9½	0 9	0 8	0 8	0 7½	0 7	0 6	0 5	0 5	0 5	A
broad...	1 3	1 2	1 1	1 1	1 1	1 0	2 0	1 11	1 10	1 7	B
And the upper and lower Strake.........*thick*...	0 8½	0 8	0 7	0 7	0 6½	0 6	Two Strakes, each wrought Top and Butt.				C
broad...	1 1	1 1	1 0	1 0	1 0	0 11					D
Which number of Strakes are to be reduced afore and abaft to................................	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	E
And in thickness *(within about 9 feet of the extreme)*..	0 6	0 6	0 5	0 5	0 4½	0 4	0 4	0 3	0 3	0 3	F
Thickstuff at the first Futtock Heads, or Middle Bands, in Merchant Ships, *number of Strakes*	*three*	*three*	*three*	*three*	*three*	*three*	*four*	*four*	*four*	*four*	G
The middle Strake, or Strakes, wrought on the joint, to be .... } *thick*...	0 8	0 8	0 7	0 7	0 6½	0 6	0 6	0 5	0 5	0 5	H
broad...	1 5	1 5	1 4	1 3	1 3	1 2	2 2	2 0	2 0	1 10	I
And the Strakes, or Strake, above, below those over the joints, to be...... } *thick*...	0 7	0 7	0 6	0 6	0 5½	0 5	0 5	0 4	0 4	0 4	K
broad..	1 3	1 2	1 1	1 1	1 1	1 0	1 10	1 8	1 8	1 8	L
Which number of Strakes forward and aft may be reduced to......................................	*two*	*two*	*two*	*two*	*two*	*two*	*three*	*three*	*three*	*three*	M

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
—	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	Fitted with bins against the side, and after bulkhead, and shelves over them.																	
B	Fitted as the cabins forward.																	
C	Fitted with a bin against the side, and shelves around.																	
D	*starboard side of powder-room door to build a Dispensary for the Surgeon, fitted with shelves, and sometimes a birth for the Purser's*																	
E	*To build a 1¼ inch rabbeted deal bulkhead, at the foreside of the platform, with a door on the larboard side, as an entry into the after hold.*																	
F G H	For the cables, and to be framed, fitted in all respects, and laid the same as the midship part of the Orlop in line of battle ships.																	
I	Especially the Beams next the Masts. The Lodging Knees fay home to the timbers.																	
K	*end, the Stantion kept upon the platform.*																	
L	0 3	0 3	0 2½	0 2	0 3	0 2	0 2	0 2	0 3	0 3	0 3	0 3	0 3	0 2½	0 2	0 2	0 2	0 2
M	0 11	0 11	0 11	1 3	0 11	0 9	0 9	0 9	Over the heels of the Lower Futtocks.									
N	*two*	*two*	*two*	*two*	*one*	*two*	*two*	*two*	*two*	*two*	*one*	*one*	*one*	*one*	*one*	*one*	*one*	*one*
O	0 5	0 5	0 4½	0 4	0 6	0 4	0 4	0 4	0 5	0 5	0 5	0 5	0 4	0 4	0 3½	0 3	0 4	0 3
P	1 0	1 0	1 0	1 1	1 1	0 11	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	0 11	0 10	0 10½	0 9
Q	0 4	0 4	0 3	0 3	0 5	0 3	0 3	0 3	0 5	0 5	0 4	0 3	0 3	0 3	0 2½	0 2½	0 3	0 2
R	1 0	0 11	0 10	0 11	1 0	0 10	0 11	0 11	0 11	0 11	1 0	0 10	0 10	0 10	0 9	0 9	0 9	0 8
S	...	...	...	...	...	...	...	...	0 4	0 4	0 3							
T	...	...	...	...	...	...	...	...	0 11	0 11	0 10							
U	0 3	0 3	0 2	0 2	0 4	0 2	0 2	0 2	0 3	0 3	0 2½	0 2½	0 2½	0 2	0 2	0 2	0 1½	0 1½
X	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*five*	*five*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*two*
Y	0 5	0 5	0 4	0 4	0 6	0 4	0 4	0 4	0 5	0 5	0 4	0 4	0 4	0 4	0 3½	0 3	0 3½	0 3
Z	1 3	1 2	1 2	1 0	1 2	0 11	1 0	0 11	1 2	1 2	1 2	1 1	1 0	1 0	0 10	0 9	0 9	0 8
A	0 5	0 5	0 3	0 3	0 5	0 3	0 3	0 3	0 5	0 5	0 3	0 3	0 3	0 3	0 2½	0 2½	0 2	0 2
B	1 2	1 1	1 0	0 9	0 11	0 10	0 10	0 10	1 0	1 0	0 11	0 10	0 10	0 9	0 9	0 8	0 8	0 7
C	...	...	...	...	...	...	...	...	0 4	0 4								
D	...	...	...	...	...	...	...	...	0 11	0 11								
E	*two*	*two*	*two*	*two*	*one*	*one*	*one*	*one*	*three*	*three*	*two*	*two*	*two*	*two*	*one*	*one*	*one*	*one*
F	0 3	0 3	0 2½	0 2	0 3	0 2	0 2	0 2	0 3	0 3	0 3	0 3	0 2½	0 2	0 2	0 2	0 1½	0 1½
G	*three*	*three*	*three*	*one*	...	*one*	*one*	*three*	*three*	*three*	*three*	*three*	*two*	*two*				
H	0 5	0 4	0 4	0 3½	...	0 3	0 3	0 4	0 4	0 4	0 4	0 4	0 4	0 4				
I	1 2	1 1	1 1	0 10	...	0 10	0 11	0 11	1 0	1 0	1 0	1 0	1 0	1 0				
K	0 4	0 3	0 3	...	...	...	...	0 3										
L	1 0	0 11	0 10	...	...	...	...	0 10										
M	*two*	*two*	*two*	...	...	...	...	*two*	*two*	*two*	*two*	*two*	*two*	*two*				

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
THICKSTUFF—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
And in thickness (*within about eight feet of the extreme*	0 4	0 4	0 4	0 4	0 3½	0 3	0 3	0 3	0 3	0 3	A
FOOTWALING between the Thickstuff.—The Footwaling between the Limbers and Floorheads—*thick*..	0 6	0 6	0 5	0 5	0 5	0 4½	0 4	0 4	0 4	0 4	B
The Footwaling between the Floor-heads, and First Futtock heads, *thick*	0 5	0 5	0 4	0 4	0 4	0 3½	0 3	0 3	0 3	0 3	C
The Footwaling above the Thickstuff at the Floor-heads and Middle Bands to be in thickness	...	...	...	...	...	...	...	...	...	...	D
LOWER DECK TRANSOM KNEES, and TRANSOM KNEES.—See TRANSOMS.											
SLEEPERS or POINTERS.—On each side ....*Number*...	*three*	*three*	*three*	*three*	*three*	*three*	*two*	*two*	*two*	*two*	E
Sided......	0 11	0 11	0 10½	0 10½	0 10	0 10	0 10	0 9½	0 9½	0 9	F
Arm next the side, long	13 0	13 0	12 0	12 0	11 0	11 0	10 0	9 6	9 6	9 0	G
Those made of iron to weigh about	...	...	...	...	...	...	...	...	...	...	H
Bolts in number in the Fore and Aft or Side Arm	*eight*	*eight*	*seven*	*seven*	*seven*	*seven*	*six*	*six*	*six*	*six*	I
and diameter	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	K
*** The Arms that fay against the Transoms are to stand square thereto, and to take two bolts through as many Transoms as											L
frigates. The foremost to clear the toe of the Deck or Wing Transom Knee. Of that next the middle line, the head fays											M
CRUTCHES.—In the Run Abaft,..................*Number*...	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	N
Sided......	1 3	1 2	1 1	1 1	1 1	1 0	0 11	0 10½	0 10	0 9½	O
Length of the Arms each	9 0	8 6	8 3	8 0	8 0	7 6	6 9	6 6	6 0	5 9	P
Bolts, in *number*	*twelve*	*twelve*	*twelve*	*twelve*	*twelve*	*ten*	*ten*	*eight*	*eight*	*eight*	Q
Diameter	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	R
If Iron Crutches, each to weigh about	...	...	...	...	...	...	...	...	...	...	S
*** *The Crutches to stand square with the body, and equally spaced; the foremost crutch nearly under the mizen-mast, the other two between that and the inner post.*											
MAIN STEP.—The Main Step to be sided	3 6	3 4	3 2	3 0	2 10	2 8	2 6	2 6	2 6	2 4	T
Deep upon the Kelson	1 6	1 5	1 5	1 5	1 4	1 3	1 2	1 2	1 2	1 2	U
In length (or to slide easily by the Well Stantions)	...	...	...	...	...	...	...	...	...	...	X
*** *To have set Bolt holes, bored into the Kelson, about nine inches from the Step, one forward and one aft, that the Step may be wedged to the rake of the mast at pleasure. The bolts about 1⅛ inch diameter.*											
FORE STEP*.—The Fore Step to be made by two hooks, each sided	1 2	1 1	1 1	1 1	1 0	0 11½	0 11	0 11	0 11		
In the clear asunder equally from the mast's centre	4 9	4 6	4 5	4 4	4 3	4 2	4 0	3 10	3 9		
Each in length	18 0	17 0	16 0	16 0	15 0	14 0	13 0	12 0	12 0		
Bolts in number in each	*twelve*	*twelve*	*twelve*	*twelve*	*ten*	*ten*	*ten*	*ten*	*ten*	*eight*	Y
Diameter	0 1½	0 1⅜	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	Z
To be fitted with a Carling on each side the middle line, let into the hooks, carling like — *Broad*	1 0	1 0	0 11	0 11	0 11	0 10	0 10	0 10	0 10		
Deep	1 6	1 6	1 4	1 2	1 2	1 2	1 2	1 1	1 1		
Fore Step made in one, to be sided (and the middle placed under the centre of the mast...	...	...	...	...	...	...	...	...	...	2 0	A
Length	...	...	...	...	...	...	...	...	...	11 0	B
To have two Oak Carlings one on each side the Kelson, each piece to lie fore and aft to receive the Main Step. To be — *Deep*	...	...	...	...	...	...	...	...	...	...	C
Broad	...	...	...	...	...	...	...	...	...	...	D
If not three Kelsons............*Long*	...	...	...	...	...	...	...	...	...	...	E

* The fore step is to chock up from the Kelson, to the depth of the mast's heel, with a piece of oak, broad enough for the carling to rabbet on. The insides of the carlings to be let down so as to form the tapering of the mast's heeling, and to score or let on upon the hooks 1½ inch aloft. The distance between the hooks is to be filled up with sliding chocks to the size of the mast's heeling, the fore and aft way. The shifting chocks may be

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
—	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. ip.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	0 3	0 3	0 3	0 2	...	0 2	0 2	0 2½	0 2½	0 2½	0 2	0 2	0 2	0 2				
B	0 3	0 3	0 2	0 2	0 3	0 2	0 2	0 2½	0 3	0 3	0 3	0 3	0 3	0 3	0 2½	0 2	0 2½	0 2
C	0 3	0 3	0 2	0 2	0 3	0 2	0 2	0 2½										
D	...	...	...	...	...	...	...	...	0 4	0 4	0 4	0 3	0 3	0 3	0 2½	0 2	0 2½	0 1½
E	*two*	*two*	*one*	...	...	...	...	...	*two*	*two*	*two*	*two*	*two*	*two*				
F	0 8¹	0 8	0 7½															
G	8 6	8 6	8 0															
H	...	...	...	...	...	...	...	*cwt.*	4 3 0	4 1 0	3 3 0	3 1 0	3 0 0	2 3 0				
I	*five*	*five*	*five*	...	...	...	...	...	*seven*	*seven*	*six*	*six*	*six*	*five*				
K	0 1	0 1	0 1	...	...	...	...	...	0 1⅜	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1				
L	possible. The heads of the Sleepers to run up to the upper side of the Deck Transom, in larger ships, and Wing Transom in																	
M	against the Sternson Knee in large ships, at the next Transom below the Deck, and the middle one equally between.																	
N	*two*	*two*	*two*	*two*	*three*	*one*	*one*	*one*	*three*	*three*	*two*	*two*	*two*	*two*	*one*	*two*	*two*	*one*
O	0 9	0 8½	0 8	0 7	0 9	0 7	0 7	0 8	...	...	...	...	...	...	...	0 7	0 7¾	0 6½
P	5 6	5 6	5 6	5 0	6 0	5 6	5 6	6 0	7 6	7 0	6 9	6 6	6 0	6 0	5 6	5 9	5 9	4 9
Q	*eight*	*eight*	*eight*	*six*	*eight*	*six*	*six*	*six*	*ten*	*ten*	*ten*	*eight*	*eight*	*eight*	*six*	*six*	*six*	*six*
R	0 1	0 1⅛	0 1	0 0⅞	0 1⅛	0 0⅞	0 0⅞	0 0⅞	0 1⅜	0 1⅜	0 1¼	0 1⅛	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 0¾
S	...	...	...	...	...	...	...	*cwt.*	3 2 10	3 1 0	2 2 14	2 1 0	2 0 14	2 0 0	1 3 0			
T	2 0	1 10	1 8	1 6	2 0	1 10	1 10	2 2	2 4	2 3	2 2	2 0	1 10	1 9	1 8	1 4	1 6	1 4
U	1 1	1 1	1 1	1 0	1 0	1 0	1 1	1 5	1 3	1 3	1 2	1 1	1 1	1 0	0 11	0 10	0 10	0 10
X	...	...	...	...	...	...	...	...	6 0	6 0	5 0	5 0	4 9	4 9	4 6	4 6	4 0	4 0
Y	*eight*	*eight*	*eight*	*six*	*eight*	*six*	*six*	...	...	...	...	*eight*	*eight*	*eight*	*eight*			
Z	0 1⅛	0 1⅛	0 1	0 0⅞	0 1⅛	0 0⅞	0 0⅞	...	...	...	...	0 1¼	0 1⅛	0 1	0 0⅞			
A	1 10	1 8	1 6	1 3	1 5	1 6	1 4	...	2 2	2 1	2 0	1 10	1 8	1 6	1 4	1 5	1 3	
B	10 0	9 0	8 6	6 0	12 0	7 6	7 6	...	6 0	6 0	6 0	9 6	9 0	8 0	7 9	7 6	6 0	
C	...	...	...	...	...	...	...	...	1 3	1 2	1 1							
D	...	...	...	...	...	...	...	...	1 3	1 1	1 0							
E	...	...	...	...	...	...	...	...	26 0	21 0	16 0							

made of 3-inch plank, of a parallel thickness, and the chock on each side the mast heel may be of the same thickness on the upper side; but the underside must increase its thickness to the taper of the heeling. Each chock to have an iron ring and start driven in its upper side.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
FORE STEP—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
To have two Oak Carlings, one on each side, at the main Step, to receive the Forestep, to be *square*..........	...	...	...	...	...	...	...	...	...	...	A
And sufficiently long to take Bolts through five Floors. The Bolts to have two drifts of size. *Bolts diameter*..........	...	...	...	...	...	...	...	...	...	...	B
If not Three Kelsons.—Each Carling to be bolted through every Floor and Lower Futtock, from the outside. *Bolts diameter*..........	...	...	...	...	...	...	...	...	...	...	C
BREAST-HOOKS.—To have Breast-hooks equally spaced between the Fore Step and Lower Deck Hook, *in number*..........	*five*	*five*	*four*	*four*	*four*	*four*	*four*	*three*	*three*	*three*	D
The Upper Breast-hook in length..........	18 0	18 0	17 0	16 0	16 0	16 0	16 0	15 0	15 0	15 0	E
The Lower Breast-hook in length..........	16 0	16 0	15 0	12 0	13 0	12 0	12 0	12 0	12 0	12 0	F
Each sided......	1 4	1 3	1 3	1 3	1 2	1 1	1 0	0 11½	0 11	0 10½	G
Bolts in number ... in the... *Upper Hook*..........	13	13	13	13	11	11	11	11	11	11	H
Lower Hook..........	11	11	11	11	9	9	9	9	9	9	I
In diameter..........	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	K
The Breast-hooks to stand square with the body as nearly as possible. Those of Iron to weigh about, *each**..........*cwt.*	...	...	...	...	...	...	...	...	...	...	L
FLOOR RIDERS.—To have Floor Riders, *in number*	*five*	*five*	*four*	*four*	*four*	*four*	...	...	...	...	M
in length........	31 0	30 0	28 0	24 0	24 0	23 0	...	...	...	...	N
Sided..........	1 6	1 5	1 5	1 5	1 4	1 3	...	...	...	...	O
Deep on the Kelson, not less than	1 5	1 4	1 4	1 4	1 3	1 2	...	...	...	...	P
Moulded at the Floor Head on the thickest Strake..........	1 4	1 3	1 2½	1 2	1 1	1 0½					
Bolts in each, *in number*......	12	12	12	10	10	10	...	...	...	...	Q
diameter.....	0 1½	0 1½	0 1½	0 1⅜	0 1⅜	0 1⅜	...	...	...	...	R
LOWER FUTTOCK RIDERS, sided	1 5	1 4	1 3	1 3	1 3	1 2					
Number on each side..........	*eight*	*eight*	*six*	*six*	*six*	*six*					
Moulded at the Floor Heads on the thickest Strakes	1 4	1 3½	1 3	1 3	1 2	1 1					
Moulded at the Heads	1 2	1 1	1 0½	1 0	1 0	0 11					
The lower Ends not to reach the Kelson by......	2 9	2 6	2 3	2 0	2 0	2 0					
And not to leave less whole wood at the ends than..........	0 6	0 5	0 5	0 4	0 4	0 4					
The Heads to reach upwards, to give scarph to second Futtock Riders..........	8 9	8 6	8 4	8 3	7 9	7 6					
Such as fay to the sides of the Floor Riders to be, *in number*......	*three*	*three*	*two*	*two*	*two*	*two*					
Bolted thereto fore and aft with square iron, *diameter*.......	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1¼	0 1¼					
To have Cross-chocks fayed with a Hook, and *deep on the Kelson*......	1 5	1 4	1 4	1 4	1 3	1 2					
Butt Scarphs across the Heels of the Lower Riders, *Scarphs, long*.......	5 0	4 9	4 6	4 3	4 0	4 0					
Bolts through the Cross-chocks, *in number*......	*eight*	*eight*	*six*	*six*	*six*	*six*					
diameter.....	0 1½	0 1½	0 1⅜	0 1⅜	0 1⅜	0 1¼					
Fore and Aft Bolts through the Cross-chocks and Floor Riders, square iron *number* .	*eight*	*eight*	*six*	*six*	*six*	*six*					
diameter	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1⅛					
SECOND FUTTOCK RIDERS.—On each side, *number*........	*eight*	*eight*	*six*	*six*	*six*	*six*					
Sided..........	1 3	1 2½	1 2	1 2	1 2	1 1					
Length sufficient to scarph under the head of the Floor Rider, and to continue upwards to the lower side of the Orlop Beams.											
The scarphs to have a Hook Butt, and length...	3 0	3 0	3 0	3 0	2 9	2 9					

* To have one or two thin square plates of Iron let in behind the arms of all Iron Breast-hooks, and Standards, against the Bow and Stem Post, Wing Transom, and all Iron Knees, or as many as shall be required. (See Midship Sections Plate 8.) All the Bolts in ditto to have stout

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigan-tine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	...	...	...	...	...	...	...	...	1 2	1 1	1 0							
B	...	...	...	...	...	...	...	...	0 1⅜	0 1⅜	0 1¼							
C	...	...	...	...	...	...	...	...	0 1¼	0 1¼	0 1⅛							
D	*three*	*three*	*two*	*two*	*three*	*three*	*three*	*three*	*four*	*four*	*four*	*four*	*four*	*three*	*three*	*three*	*three*	*two*
E	14 0	13 0	12 0	9 0	12 0	10 0	10 6	10 0	17 0	16 0	15 0	14 0	13 0	12 0	11 0	10 0	10 8	9 0
F	12 0	11 9	11 6	8 0	12 0	9 0	9 0	9 0	15 0	14 0	13 0	12 0	11 0	10 0	9 0	9 0	9 6	9 0
G	0 10	0 10	0 8½	0 8	0 9	0 9	0 9	0 8½	1 2	1 1	1 0	0 11	0 10	0 9	0 8¾	0 8½	0 8½	0 7
H	11	9	9	7	9	7	7	7	13	13	11	11	9	9	9	9	7	7
I	9	9	9	7	9	7	7	7	11	11	9	9	9	7	7	9	7	7
K	0 1⅛	0 1⅛	0 1	0 1	0 1⅛	0 1	0 1	0 1	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1⅛	0 1	0 1	0 1	0 0¾	0 0¾
L	...	...	...	...	...	...	...	...	8 0 0	8 0 0	8 0 0	6 2 0	6 0 0	5 2 0	5 0 0			
M	The Iron Riders of India ships to be let into the Tim-								*five*	*five*	*five*	*four*						
N	bers, four in number, under the Main Mast, or nearly								18 0	17 0	16 0	15 0						
O	so, and three forward.......................................								0 5½	0 5½	0 5¼	0 5						
P	*** *Observe to clear the pumps, &c.*								8 0 0	7 2 0	7 0 0	6 2 0						
	To be Iron								Each in Weight as above									
Q	...	...	...	...	...	...	...	...	12	12	12	10						
R	...	...	...	...	...	...	...	...	0 1⅜	0 1⅜	0 1⅜	0 1¼						

upset Heads, and to fill up the Holes, driven from the inside, and carefully clenched (the Points being made hollow purposely) upon the outside Plank; the rings all carefully let in flush, and the points of the Bolts well clenched.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
Riders—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	—
The scarphs to have a Hook Butt, and *moulded*	1 3	1 2½	1 2	1 2	1 2	1 1					
Bolted with Bolts in *number*........................	*eight*	*eight*	*eight*	*seven*	*seven*	*seven*					
diameter	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1¼					
Third Futtock Riders*.—On each side, *Number*......	*eight*	*eight*	*six*	*six*	*six*	*six*					
sided......	1 3	1 2½	1 2	1 2	1 2	1 1					
Length, sufficient to scarph (as second futtock rider) on to the head of the lower rider, and to continue upwards to the underside of the gun deck beams; and to face on and tail to the sides of the Orlop beams.—Bolted with Bolts, in *Number*	*nine*	*nine*	*eight*	6*or*7	6*or*7	*six*					
Diameter..........	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1¼					
Moulded...........	1 3	1 2	1 2	1 2	1 1	1 0					
Pillars in the Hold under Gun-deck, Lower-deck, or Orlop beams.—To be square along the middle ¾ of their length..............................	1 1	1 0	1 0½	1 0	0 11	0 10	*square*	...	...	...	A
At the lower end to be fore and aft...............	1 4	1 3	1 2	1 2	1 1	1 1	0 10	0 8½	0 8½	0 8	B
Thwartships................	1 2	1 2	1 1	1 1	1 0	1 0	*square*	...	...	...	C
At the upper end to be fore and aft...............	1 2	1 2	1 1	1 1	1 0	1 0	0 9	0 7½	0 7½	0 7	D
Thwartships...............	1 1	1 1	1 1	1 1	1 0	1 0	...	...	...	...	E
The pillars to trance in from each end to the size given ⅔ their length.†											
Well.—The Well to be fore and aft in the clear.........	11 9	11 3	10 6	10 0	9 0	8 6	8 3	8 0	7 9	7 3	F
Thwartships..................	10 0	9 3	8 6	8 3	7 9	7 6	7 3	7 0	6 9	6 6	G
The corner Stantions‡ to be harriscut from a square carling......................................	1 2	1 2	1 1	1 1	1 0	1 0	1 0	0 11	0 11	0 10	H
Middle Stantions broad and an inch less thick...	0 8	0 8	0 7	0 7	0 7	0 6	0 6	0 6	0 6	0 6	I
The sides to be English oak plank cyphered and thick..	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	K
Stantions square......................................	0 8	0 8	0 7	0 7	0 7	0 7	0 6	0 6	0 6	0 6	L
Shot Lockers.—To have a Shot Locker, afore and another abaft, the Well, of the same breadth athwartships, built of cyphered plank, the same as that of the Well, with shelving flaps hung with hinges. Each Shot Locker fore and aft in the clear......................... ...	2 9	2 6	2 4	2 2	2 2	2 1	2 0	2 0	2 0	2 0	M
To have a partition in the middle, thick.........	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	N
To have a Shot locker built forward, abaft the magazine bulkhead, between the after riding bitts, similar to those as to plank. To be fore and aft in the clear..............................	3 6	3 3	3 0	2 10	2 8	2 6					
and thwartships..................	9 6	9 0	8 6	8 0	8 0	7 9					
FORE MAGAZINE.—The after bulkhead abaft the foremost perpendicular about..................	44 0	42 0	43 0	42 6	36 6	35 0	35 0	34 9	33 9		
Foremost bulkhead of the light-room afore the after bulkhead of the magazine, in the clear...	31 0	31 0	30 6	30 0	26 0	26 0	18 0	17 0	16 0		
Bulkheads to be of English oak plank rabbetted and thick..	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3		
Stantions (to be on the foreside of the bulkhead) English oak, square..............................	0 8	0 7	0 7	0 6½	0 6½	0 6	0 6	0 6	0 6		
Stantion that comes in the range of the wing stantions, broad..................................	1 6	1 5	1 5	1 4½	1 4	1 3	1 3	1 2	1 2		
Stantions of the bulkhead in the clear asunder...	2 9	2 9	2 9	2 9	2 9	2 9	2 7	2 7	2 7	...	O
Height from the upperside of the magazine flat to the underside of the flat above..............	9 0	9 0	8 9	8 9	8 0	7 0	6 6	6 3	6 0		

* The upper part of the Lower Futtock Riders and lower part of the second Futtock Riders, and the upper part of the second Futtock Riders and lower part of the third Futtock Riders, are to be fayed close together sideways, and bolted to each other the fore and aft way, with two bolts in each scarph, with square iron, of the same size as the Bolts through the side. And likewise bolted through the respective beams they face on.

† Those pillars that come in the range of a bulkhead stand contrary to the others, that the sides may be straight, and the edges should be taken off with a bold chamfer, except those against bulkheads.

‡ The corner stantions; the heels to be let down in the footwaling one inch, and up in the beams the same, unless they lap to the sides, and

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	...	...	...	...	...	...	...	...	0 11	0 10½	0 10	*square*						
B	0 7½	0 7½	0 7	0 5	0 7	0 5	0 5	0 5	1 1	1 1	1 0	0 8	0 7	0 6	0 5	0 6	0 6	0 6
C	...	...	...	...	...	...	...	...	1 0	1 0	0 11	*square*						
D	0 6½	0 6½	0 6	0 4	0 6	0 4	0 4	0 4	1 0	1 0	0 11	0 7	0 6	0 5	0 4	0 5	0 5	0 5
E	...	...	...	...	...	...	...	...	1 0	1 0	0 11							
F	7 0	6 9	6 6	3 0	5 0	3 6	3 6	3 0	8 0	8 0	8 0	7 9	7 0	5 0	3 0	1 6	2 0	
G	6 3	6 0	5 6	3 9	4 9	4 3	4 6	4 0	6 0	6 0	6 0	5 9	5 3	4 9	4 6	4 0	4 6	
H	0 10	0 9	0 8	0 7	0 8	0 7	0 7	0 7	0 8	0 8	0 7	0 6½	0 6	0 6	0 5	0 6	0 6	
I	0 5	0 5	...	...	...	...	...	...	0 6	0 6	0 6	0 5	0 5	0 4				
K	0 3	0 3	0 2	0 2	0 2	0 2	0 2	0 2	0 3	0 2½	0 2½	0 2	0 2	0 2	0 2	0 2	0 1½	
L	0 6	0 6	0 5															
M	2 0	2 0	1 10	...	2 0	1 6	1 6	1 6										
N	0 2	0 2	0 2															
O	Let in at the heel one inch into the footwaling, and the head ¾ of an inch into the beams.																	

are there bolted. In the navy, the wells are of plank up to the upper side of the Orlop beams, or lower deck in frigates; and the plank on the sides runs forward and aft sufficiently to take and fasten to the cant before or abaft the shot-lockers. In merchant ships, the wells are birthed up with oak plank sufficiently above the ballast; and, above that, deal of the same thickness. In the navy, above the Orlop or Lower Deck, the well is fitted with 1¼ loovered battens, with a platform and lockers, and a door forward on the starboard side. The battens are let in looverwise into oak stantions, a large chamfer taken off inside, and on the outside a bold round.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
Fore Magazine—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Length of the Magazine Flat or Platform........	14 0	13 0	12 0	12 0	10 0	9 0	12 0	12 0	12 0		
Magazine Platform Beams to be English Oak, square........	0 9	0 9	0 9	0 8½	0 8	0 8	0 7	0 7	0 7		
Asunder in the clear (to have a Scuttle in the middle)........	2 6	2 6	2 4	2 4	2 4	2 4	2 2	2 2	2 2		
The Flat to be English Oak Plank, thick (and caulked)........	0 3	0 3	0 3	0 3	0 2½	0 2½	0 2½	0 2½	0 2½		
Wing Stantions or Munions, Midship-side, from middle line........	15 0	15 0	15 0	14 0	11 9	9 6	8 3	8 0	8 0	...	A
Wing Stantions or Munions to be of East Country, or English Plank *broad*	0 10	0 10	0 10	0 10	0 10	0 10	0 9	0 9	0 9		
thick	0 6	0 6	0 6	0 6	0 6	0 6	0 5	0 5	0 5		
To have Rabbets sunk in the edges next the side of........	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	0 2	0 2	0 2		
To have Oak Sills let into the Munions, *deep*....	1 0	1 0	0 11	0 10	0 10	0 10	0 9	0 9	0 9	...	B
With the Munions, the Sills to be *thick*..........	0 4	0 4	0 4	0 4	0 4	0 4	0 3	0 3	0 3	...	C
To have Oak Chocks fayed upon the Footwaling, as broad as the Munions; the lower ends to snape upon the Magazine											D
The said Oak when fayed to leave a Water-course of........	0 5	0 5	0 5	0 5	0 5	0 4	0 4	0 4	0 4		
The Flat of the Watercourse to be thick (English Plank)........	0 3	0 3	0 3	0 3	0 2½	0 2½	0 2½	0 2½	0 2½	...	E
Wing Pannels to be made of rabbeted 1¼ inch deal, double lined with slit deal inside, and single lined outside; fitted close											F
Upon the Magazine Platform to have palletting Beams of Fir, *square*........	0 7	0 7	0 7	0 7	0 7	0 7	0 7	0 7	0 7	...	G
palletting Beams are let down Fir Carlings, the same size as the Beams, with Rabbets in their edges, corresponding to Beams are apart; but into the sides to contract the size as the shape of the body may require.											H
The Flat of the palletting to be made of flat scuttles, of 1½ inch deal, fayed into the Stops or Rabbets, and lined underside											I
The foremost Wing Stantion to have a Rabbet on the foreside, to take a 3 inch Oak or Fir Bulkhead into the side, which											K
The Platform in the Wings to be 1½ inch elm board, kept level 3 inches below the upper sides of the lower Sills, bored											L
At the fore part of the Magazine upon the foremost palletting Beam to fay a 4 inch East Country Plank, from side to side,											M
The aftside of the Magazine Bulkhead in the Hold, is, for security from fire, covered with inch Oak Battens, 4 inches											N
ing plastered, and over that a dry slit deal lining. The inner lining to be fastened with copper brads. The foreside of											O
asunder alternately. Fore part of the Magazine to be parted from the Light-room with Stantions of Fir, 6 inches square,											P
one opening on the larboard side, as a passage into the Magazine. These are made so as to shift occasionally. In the same											Q
Dunnage Battens.—The Flat of the palletting to have Dunnage Battens, about 2 inches square, nailed down with copper											R
admit, parallel to the Stantions; and 3 inches on each side those lines nail down the Battens. Chamfer or round the											S
Filling-room.—To make a Filling-room before the Magazine under the Lights.											
Filling-room, *in length*........	8 0	8 0	7 0	7 0	6 6	6 0	5 0	5 0	5 0		
Beams for the Flat, *in number*........	*three*	*three*	*three*	*two*	*two*	*two*	*two*	*two*	*two*	...	T
square........	0 8	0 8	0 8	0 7½	0 7	0 7	0 7	0 7	0 7	...	U
Filling-room, *broad*........	5 0	4 9	4 6	4 4	4 2	4 2	4 0	4 0	4 0		
and deep........	1 3	1 2	1 0	1 0	1 0	1 0	0 11	0 11	0 11		
To frame under the Flat of Filling-room Fir Carlings and Ledges, *square*...... *Carlings*	0 6	0 6	0 6	0 6	0 6	0 5	0 5	0 5	0 5		
Ledges	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 3		
To lay the Flat of the Filling-room with 1½ inch deal, and to line the Flat and Sides of the same with lead, of 4lbs. to											X
The side next the Filling-room upon which Cartridge Racks are built, is framed with ledges of 4 inch Plank, let down upon											Y
The Jambs for fixing the Lights to be fixed at about........	1 3	1 2	1 1	1 1	1 1	1 0	1 0	1 0	1 0	...	Z
Jambs, in *number* 4; *broad*........	1 8	1 8	1 8	1 8	1 6	1 6	1 6	1 6	1 6	...	A
thick........	0 6	0 6	0 6	0 6	0 6	0 6	0 5	0 5	0 5	...	B
Asunder in the clear........	1 10	1 10	1 10	1 10	1 10	1 10	1 10	1 10	1 10	...	C
Asunder equally from middle line, the Midship Jambs........	1 4	1 4	1 4	1 4	1 3	1 3	1 2	1 1	1 1	...	D
Spla-boards, in *number* 2; one next each side, *each broad*........	2 2	2 2	2 0	1 10	1 9	1 9	1 8	1 8	1 8	...	E
thick........	0 6	0 6	0 6	0 6	0 6	0 6	0 5	0 5	0 5	...	F
Bolts diameter..	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾		
On the aftside of the Spla-boards, next the Midships, Rabbets are taken out to receive the side Munions of the Sashes											G
may turn up under the Beams above. The Sash Munions are to be thick enough to have two rabbets on their edges;											H
and turns up as the Sash. To have one Munion fixed in the middle line.											

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544.	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*

A At the after ends, and continue forward to clear the Wing Scuttles overhead.

B And overhead flush with the undersides of the Beams. The Sills to have Rabbets to correspond.
C The Sills to fay upon the Flat of the Watercourse.
D Platform Beams, and the upper ends against the Munions or Pannel Stantions.

E The lower edge to mitre against the Flat of the Platform, the upper edge to run up under the Sills, and to be square edged and caulked.
F with flannel into the Rabbets of the Stantions, and bolted in the Magazine with stop-copper-bolts.

G Fastened with treenails directly over the Platform Beams. To have Rabbets of 1½ inch grooved out of the upper edges. Into the
H those in the Beams; the middle tiers to be equally spaced from the middle line, and parallel thereto, to the distance the palletting

I with ½ inch elm board, or slit deal. Into the side of the Flat may be 1½ inch deal fastened down.
K is made watertight.
L with holes for a passage to the water, and yet to prevent any from falling under the Watercourses.
M against the Flat of the Watercourse, to be one foot deep, fastened with treenails, and caulked.
N broad, over all the joints, and plastered behind with mortar; the foreside of the Bulkhead is double lined, first with a slit deal lin-
O Stantions are made flush with 1½ inch thick, and 4½ inch broad, for Battens, let 1 inch into the Stantions, and 4 inches parallel
P and Battens mortised into the Stantions similar to those at the after Bulkhead; the Stantions about 2 feet 9 inches asunder, leaving
Q manner the Magazine is parted off fore and aft in the middle, or nearly so, the middle opening to have shifting Battens as a passage.
R nails, thus: from the insides of the Stantions of the after Bulkhead set off as many 23 inches as the length of the palletting will
S upper edges, and cut the Battens asunder in the joints of the Scuttles that they may be shifted.

T, U { The Beams to be let down upon the Footwaling, the upper sides with a range of the upper side of the palletting Flat, and upon the said Beams, to raise the sides and fore end of the Filling-room with 4 inch Oak Plank or Fir edgewise.

X the square foot.
Y the sides of the Filling-room and Footwaling, and upon those ledges is to be laid a flat of 1¼ inch rabbetted deal.

Z In the clear afore the Filling-room, and fixt fore and aft equally from the middle line.

A, B, C, D, E, F { The Jambs and Spla-boards at the Head and Heel to be let into the Footwaling and Beams about ⅞th of an inch, and to be rabbetted together at the edges, fixed up in the most substantial manner, and bolted at the Heads and Heels. The Lights are fixed between the Jambs at a proper height to admit light down upon the Filling-room. On the aftside of the Jambs in the Midships a Rabbet is taken out for the 1½ inch deal Bulkhead, which is lined with lead on the aftside of 4lbs. to the foot square, as are likewise the Jambs, and every where near the lights.

G (which are glazed with stone-ground glass) one before each light, the upper sides are hung with brass hinges to the Headstile, that the Sash
H one to receive the Sash, and the outer one a shutter or guard, made of inch deal, opened so as not to obstruct the light which hangs

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
FILLING ROOM—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
To build a bulkhead, next the side within the range of the wing scuttles of... *Deal, thick*.........	0 2½	0 2½	0 2½	0 2½	0 2	0 2	0 2	0 2	0 2	*if room admit*	A
Fir stantions, square	0 5	0 5	0 5	0 5	0 4½	0 4½	0 4	0 4	0 4		B
To build a bulkhead of 1¼ inch rabbetted deal about..	2 0	2 0	1 10	1 10	1 8	1 7	1 6	1 5	1 4	...	C
Against the empty barrel room bulkhead, to build racks for holding filled cartridges. Thus, fix up fir stantions about four											D
thus, let the lower shelf be about four inches up from the flat, for a drawer to slide under it to catch the loose powder. Let											E
may be made of 1¼ inch board, opened, or 1½ laths fastened with copper nails, on the bearers, leaving space between each lath											F
shift occasionally. The battens to be fir, 3½ broad and ¾ of an inch thick; each batten placed three inches asunder, with											G
made to fit. Generally the battens are to be fixed at the shelves, keeping the underside of the batten flush with the underside											H
MAGAZINES and POWDER ROOMS have their passages lined with lead, 5lbs. to the foot square, and turned up five inches at the sides											I
lower sills of the doors not to be less than seven inches deep, and the doors to be plastered with mortar inside and out,											K
to prevent accidents to magazines and powder rooms by lining their bulkheads with plaster of mortar and hair within											L
ledges, and over that, on the inside, a dry lining of slit deal covering the joints of the first lining. Over head the joints											M
not be considered as secure from fire, unless constructed water tight, with their insides and outsides sheathed with thin											N
dreadful effects. By the foregoing precautions the mischievous effects of rats will also be prevented.											
AFTER MAGAZINE.—The Magazine in small ships and POWDER ROOM in large ships, is generally aft. It is built at the aft side of the After-beam of the After-platform, next afore the Bread-room, complete with racks, and parted off to hold barrels similar to the Magazine forward. Distance in the clear between the bulkheads..	...	...	11 4	10 6	8 6	6 9	8 0	7 6	7 3	12 0	O
Height from the platform to the deck above.....	...	...	9 0	8 6	7 0	6 3	9 3	9 0	9 0	7 6	P
Athwartships in the clear..........................	...	...	14 0	12 6	10 0	9 6	10 6	10 6	10 0	14 0	Q
Beams of the platform (oak)................*square*	...	...	0 7	0 7	0 6½	0 6	0 6	0 6	0 6	0 6	R
Flat deal (caulked)...........................*thick*	...	...	0 2	0 2	0 2	0 2	0 2	0 2	0 2	Fitted	S
Bulkheads plank or deal rabbetted...........*thick*	...	...	0 3	0 3	0 3	0 3	0 3	0 2½	0 2½	0 2½	T
Stantions, of oak.............................*square*	...	...	0 6	0 6	0 5½	0 5	0 5	0 5	0 5	0 4½	V
asunder	...	...	2 9	2 9	2 6	2 6	2 6	2 6	2 6	2 4	W
LIGHT ROOM and Passages—*In the clear*....................	...	...	2 10	2 10	2 6	2 6	2 6	2 6	2 6	2 4	X
Through the bulkhead is let out the light, which, being small, is fixed on a stool with a bracket under it; the sides and bottom of the light is canted with fir, leaded beneath upon the stool and against the bulkhead.											
HANGING MAGAZINES in large ships, POWDER ROOMS in small ships, and LIGHT-ROOMS.—Forepart abaft the aftside of the Main Hatchway..............	27 0	25 6	...	...	...	...	...	...	...	24 6	Y
Fore and aft in the clear...........................	6 3	5 6	...	...	...	...	...	...	...	6 6	Z
Thwartships in the clear............................	9 0	8 6	...	...	...	...	...	...	...	7 0	A
Midship side from the larboard side of the middle line..	6 0	6 0	...	...	...	...	...	...	...	...	B
Bulkhead thick and rabbetted........................	0 3	0 3	...	...	...	...	...	...	...	0 2	C
Light-room.—Square in the clear.....................	2 6	2 5	...	...	...	...	...	...	...	2 2	D
Crowning below the underside of Lower-deck plank..	3 2	4 3	...	...	...	...	...	...	...	1 8	E
Flat below the underside of the Orlop flat........	2 3	3 7	...	...	...	...	...	...	...	7 0	F
Foremost Hanging Magazine is of the same dimensions as the After Hanging Magazine: but in three-decked ships it is built—Forepart abaft the aftside of the Fore-hatchway.........	4 6	4 0									
Midship side from the starboard side of the middle line..	5 0	5 0									
Light Room. To build a Light-room of 1¼ rabbetted deal to inclose the lights of the Grand Magazine........................ *Fore and aft*	12 0	12 0	11 6	10 6	10 6	12 6	4 0	3 9	3 9	...	G
Thwartships.	12 6	12 6	12 6	12 6	12 0	12 0	8 0	7 6	7 6	...	H

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
A B	The said bulkhead to continue forward about one foot before the lights; to be single lined with slit deal on the outside, and double lined inside; the first lining to be plastered with mortar.																	
C	Within the former bulkhead, and at the aftside, to hang a door for an empty barrel room.																	
D	inches square, two feet six inches asunder, and two feet out from the said bulkhead; then divide the height into three for the shelves,																	
E	the bearers for the shelves be 1½ inch battens, four inches deep, mortised into the stantions at the height of the shelves. The shelves																	
F	equal to its thickness. The upper sides of the laths are to be rounded. The several racks to be parted off or formed with battens to																	
G	stops into mortises in the sides of the stantions, and fillets of 1¼ batten against bulkheads. The battens in front to be marked, or else																	
H	of the shelf.																	
I	and ends. To be made flush between the stantions that the lead may be so carefully turned as to hold water when required. The																	
K	with slit deal over it. The inner door to be hung with brass butt-hinges, copper screws, and copper lock. The utmost care is taken																	
L	side, and over that a lining of slit deal, to break the joints or seams of the bulkheads, as likewise overhead between the beams and																	
M	are canted or broke with fir laths, mitered at the ends, and plastered behind. Notwithstanding all these precautions, magazines can-																	
N	copper, so that should fire happen in any part of the ship, the repositories for powder may be readily filled with water to prevent its																	
O	11 6	11 6	11 6	...	6 9	12 6	13 6	10 0										
P	7 3	7 0	4 9	...	8 2	4 6	5 0	4 6										
Q	13 0	12 0	11 6	...	11 0	9 0	9 6	9 0										
R	0 6	0 6	0 5½	...	0 5½	0 5	0 5	0 5										
S	with palleting as forward.				0 1½	0 1½	0 1½	0 1½										
T	0 2½	0 2½	0 2½	...	0 2½	0 2	0 2	0 2										
V	0 4½	0 4½	0 4	...	0 4	0 3½	0 3½	0 3½										
W	2 4	2 4	2 2	...	2 4	2 0	2 0	2 0										
X	2 4	2 4	2 4															
Y	20 0	18 0	Abaft the foremost perpendicular.															
Z	6 3	6 0																
A	6 9	6 6																
B	Equally from the middle line																	
C	0 2	0 2																
D	2 2	2 0																
E	1 6	1 3																
F	6 9	6 6	Deep in the clear.															
G H	Clear of the jambs. The flat laid with 1½-inch deal. N. B. Keep the bulkhead stantions on the outsides, as the insides of all light-rooms are tinned or lined with double tin, and the flat covered with lead 5lbs. to the foot square.																	

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
FISH-ROOM.—The after Bulkhead of the Fish-room is the foremost Bulkhead of the after Magazine, but in those ships which have no Magazine abaft, the aftside of the Fish-room Bulkhead is afore the aftside of the after Beam of the Orlop......	8 0	6 6	...	...	...	...	...	...	...	...	A
And in distance from the after, perpendicular...	...	...	...	...	...	...	27 0	26 9	26 0	32 3	B
Fish-room fore and aft in the clear	10 9	10 6	9 3	9 9	9 9	9 9	9 6	9 0	8 6	7 9	C
SPIRITUOUS LIQUOR-ROOM.—The foremost Bulkhead of the Fish-room makes the after Bulkhead of the Spirit-room									...	...	D
Spirit-room fore and aft in the clear..............	7 0	6 9	6 3	7 0	6 0	5 9	6 0	5 6	5 3	5 0	E
Stantions of the Fish and Spirit-room Bulkhead, *square*....................................	0 6	0 6	0 6	0 6	0 5½	0 5½	0 5	0 5	0 5	0 5	F
Cyphered Bulkheads, English plank, *thick*.......	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 2½	G
Stantions asunder about............................	2 9	2 9	2 9	2 9	2 9	2 9	2 9	2 9	2 9	2 6	H
BREAD-ROOM.—The inside to be lined with feather-edge deal, the thick edges upwards, and completed with bins to hold oatmeal,											I
Hold against the after Bulkhead. In line of battle ships, a Bulkhead of 1¼ inch rabbetted deal is built on the foreside of											K
CARLING. To have a Carling let up 2 inches under the after Beams of the gundeck...... *broad*	1 2	1 2	1 1	1 1	1 0	1 0	...	...	...	...	L
CARLING. *deep*	1 2	1 2	1 1	1 1	1 8	1 0	...	...	...	...	M

PARTICULARS OF N

RIDERS.—Bomb Vessels are to have five Futtock Riders on each side, under each Mortar, the lower ends to reach within 2 feet of the O
and the Riders under the foremost-bed, 12½ inches. Moulded on the thickest Strakes on the floor Heads, 13 inches; P
Riders, 9 inches; to hold square the 5 inches, and at the lower ends not less than 4 inches. To have Cross-chocks Q
to butt into the Rider 1½ inch, and have 5 inches substance left there, bolted through the Rider with two bolts, ¾ of R
Chocks upon them, with bolts 1¼ inch diameter. To have Top Riders, one on each side the centre of each Mortar, S
sided at the Heels 12 inches, at the Heads 11 inches; and moulded at the Heels 10½ inches, at the Deck 9 inches, T
CLAMPS under Bomb-bed Beams.—Thick at upper edge, 7 inches; thick at lower edge, 5½ inches; thick at the extremes, 5 inches; U
below that under the Clamp, thick, 4 inches; broad, 1 foot.
BEAMS under the Mortar Beds.—To have a double Beam under the centre of each Mortar: those under the after Mortar, sided to X
moulded 11½ inches, if they are made-beams, and scarph together. Observe that the Slips come in the centre, and that Y
broad Beam; the Beams under the after-bed to be 13 inches square, and those under the foremost bed 11½ inches square. Z
each end, and the foremost and after Beam to be double knee'd, with one Hanging and one Lodging Knee at each end. The A
CARLINGS.—To have three Carlings fore and aft, scored 2 inches down upon the Riders. The Carlings to the after-bed to be 16 B
and one on each side. Their outsides to be 3 feet 8 inches from the middle line. To have also three Carlings directly C
Carlings to have a groove of 2½ inches square, in the middle, to receive the tenons of the uprights, or pillars, of an D
PILLARS under the Bomb-bed Beams.—To have 18 upright pillars under each bed, the pillars under the after-bed to be 10 inches E
the centre Beams, and 3 under each of the other Beams, are to be put up in such manner that they may in a very short F
CARLINGS for the BEDS.—To have two Carlings the whole length of the beds, 30 inches deep, and 22 inches broad, placed 10 feet G
aft, between the Carlings, 9 inches thick, scored down 1½ inch upon the Beams, and the edges to be rabbeted into each H
BOMB-ROOMS and BEDS.—To be eight-square, inclosed with thick Coamings, caulked and made tight as high as the deck, to lay thick I
each side of the bed, inside, for traversing the Mortar, of ⅞ inch diameter. To fay three small Knees, 6 inches sided, K
against the outside of the fore and aft Coaming, which frames the Bomb-room, to strengthen the same against the blow L
COAMING CARLINGS.—To have Coaming Carlings, one on each side, close to the Mortar, when stowed fore and aft, with proper M
be deep 1 foot 6 inches, and 11 inches thick; let down 1½ inch into the framing of the Bomb-room, and Beam of the N
the middle line at the fore and aft end, and to have head ledges answerable to the Coamings. The hoods to be made of O
6 inches in the breadth; the top to be 1½ inch deal, grooved and tongued together to overhang 1½ inch all round, and P
let into the sides with a tail. The under side of the top of the hood to be kept 4 feet 2 inches from the upper side of Q
SHELL-ROOMS.—To birth up with 2-inch English oak plank round the outsides of the pillars from the Bomb-beds, downwards, for R
plastered thick between the lining. The seams of the planks to be covered with oak battens on the outsides, and plaster S
mit; to be placed about 15 inches in the clear above each other (supposing a 13 inch shell) and the upper sides to have circu- T
cut as will stow the shells about 2 inches apart. Partitions of 1 inch elm board to be slid in grooves between the shells U
COOK-ROOM.—To have a convenient Cook-room upon the fore platform, with jambs and security for the fire hearth, to be lined over- X
The whole to be finished by the erection of a dresser and lockers for the cook's use.

	110	98	80	74	64	50	44	38	36	32	
GUN or LOWER DECK.—Height of gun or lower deck Clamps. See BEAMS.											
CLAMPS composed of Strakes, *in number*....................	*three*	*three*	*four*	*four*	*three*	*three*	*two*	*two*	*two*	*two*	Y
Upper Strake, *thick*..........................	0 9	0 8½	0 8	0 8	0 8	0 7	0 6	0 5½	0 5	0 5	Z
broad..........................	1 5	1 5	...	...	1 4	1 4	2 4	2 2	2 0	1 3	A
Second Strake, *thick*..........................	0 8	0 7½	2 8	2 8	0 7	0 6	...	...	...	0 4	B
broad..........................	1 3	1 3	...	...	1 2	1 1	...	...	...	1 1	C

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	...	...	...	...	...	...	...	...										
B	29 0	27 6	23 0	...	...	24 2	33 0	25 3										
C	7 6	7 3	7 0	...	...	3 0	4 6	6 6										
D	...	...	...	...	...	...	...	...										
E	4 9	4 6	4 3	...	...	...	...	...										
F	0 5	0 4½	0 4	...	...	0 4	0 4	0 4										
G	0 2½	0 2½	0 2	...	...	0 2	0 2	0 2										
H	2 6	2 6	2 6	...	...	2 4	2 4	2 4										

(A–C) When dried Fish formed a part of the provisions, this place was allotted to contain it, but it is now used as a coal-hole, or for spirits.

(D–H) The Spirit-room to be lined on the inside with a thick coat of mortar and hair, and over that a dry lining of slit deal; likewise overhead between the beams and ledges, which are canted with laths mortered behind and mitered at the ends. The Fish-room should also be lined, as it is sometimes used for the stowage of spirits.

I &c. and racks built against the Bulkhead for stowing cheeses separately. But, in small ships, the racks are built in the after
K the after Beam, the Stantions to stand aft from the Footwaling up to the underside of the deck; abaft which is called Lady's Hole.
L In length to reach from the foreside of the Mizen Step, and the after end to tenon into the Knee against the Transoms and Fillings,
M let down between the Beams, to fill up to the underside of the standard against the Transoms, and to pillar under the Carling.

N **BOMB VESSELS.**

O side of the Kelson, the upper ends to the lower side of the Bomb-bed Beams. The Riders under the after-bed to be sided 14 inches,
P the after Riders, and the foremost Riders, 12 inches. Moulded at the Heads, the after Riders 10 inches, and the foremost
Q fayed upon the Heels, which shall scarph 6 feet upon the lower end of each Rider with a Hook Butt. The ends of the said Chocks
R an inch diameter; the Cross-chocks to be deep on the Kelson 13 inches. To be bolted with 16 bolts in two opposite Riders, and
S making 8 on both sides, to reach from the gunwale downwards, and give at least 5 feet scarph to the lower Riders. The top Riders
T and at the Heads 6½ inches, and bolted about 18 inches apart with bolts 1 inch in diameter.
U broad, 1 foot 8 inches; scarphs long, 4 feet.—One Strake under the Clamp, thick, 5 inches; broad, 1 foot 1 inch.—One Strake

X gether 2 feet, moulded 13 inches, and the centre Beams under the foremost Mortar to be 1 foot 10 inches broad together, and
Y the Beam-arms be wounded as little as possible by the Pivot-hole. To have four Beams more under each bed, two before and two abaft the
Z The centre Beam to be knee'd with two Hanging Knees at each end, the Beams on each side the centre Beam, with one Hanging Knee at
A Knees sided 8 inches, and bolted with 6 bolts in each of 1⅛ inch diameter.
B inches square, and to the foremost bed sided 12 inches and 13 inches deep. One Carling to be let down in the middle line equally,
C over the lower Carlings, of the same size, and let up parallel to the under ones, under the Bomb-bed Beams 2 inches. All the said
D equal length.
E square, and those under the fore-bed to be 9 inches square, placed upon the aforesaid Carlings. Six of the pillars under each of
F time be removed or re-instated.
G asunder, or as directed; scored down 2 inches upon the Beams, and the inner edge rabbetted to lay beds for the Mortars, fore and
H other; each Strake bolted with two bolts in each Beam, ¾ of an inch in diameter.
I stuff of 6 inches athwart upon the Bomb-beds, forming a stop for the carriage of the Mortar. Two ring-bolts are to be driven in
K one on the centre Beam, and one on each Beam annexed on each side, bolted through the Beams, and the up and down that fays
L of the Mortar. The bolts to be ¾ of an inch diameter.
M rabbets on the outsides to receive hatches for covering in the Bomb-rooms, and a hood to cover the Mortar. The said Coamings to
N main deck, at the fore and after end, so as to shift occasionally, and to be kept asunder in the clear 4 feet 6 inches, equally, from
O fir, the sides and ends to be 2 inches thick, dovetailed together at the ends; the top to arch or round up athwartships not less than
P fastened to the ends. Four fir ledges to be equally spaced in the length; the ledges to be 3 inches deep, and 2½ inches thick,
Q the bed.
R Shell-rooms. The edges of the plank to be rabbetted, and the insides of the shell to be lined with slit deal, and mortar and hair
S behind the battens. To have sliding shelves, or platforms, of 3-inch elm plank, in rows as broad as the distance of the pillars will ad-
T lar beds cut in them in such a manner as that a shell may fay into them at one-third of its diameter, and as many of those beds to be
U athwartships.
X head with double tin, and the flat with lead, 7 lbs. to the foot square. The flat of the platform to be laid with 2½ English oak plank.

	Frigates 28	Frigates 24	Sloop of War 18	Denmark Yacht 10	Bomb-Vessel 12	Brigantine 10	Brig-Cutter 24	Cutter 16	East India 1257	East India 1000	East India 818	West India 544	West India 440	West India 330	Packet 201	Schooner 133	Brig 170	Sloop 60
Y	*two*	*two*	*two*	...	...	...	*one*	*one*	*two*	*two*	*two*	*two*	*two*	*one*	...	...	*one*	
Z	0 5	0 4½	0 4	...	...	...	0 4	0 3½	0 6	0 6	0 6	0 5	0 4	0 4	...	...	0 4	
A	1 2	1 1	1 1	...	...	...	1 2	1 1	1 3	1 2	1 1	1 1	1 1	1 1	...	...	0 11	
B	0 3½	0 3½	0 3	...	...	...	...	...	0 6	0 6	0 6	0 4	0 4					
C	1 0	1 0	0 11	...	...	...	...	...	1 2	1 1	1 0	1 1	1 0					

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
GUN OR LOWER DECK—*continued.*	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	
Third strake.................................*thick*.....	0 7	0 6½	0 7	0 7	0 6	0 5					
broad....	1 2	1 2	1 2	1 2	1 1	1 0					
The clamps in four or two strakes may be wrought top and butt, and tabled one into the other on the edges, about 1¼ inch deep; but when wrought in three strakes the upper strakes scarph together with a hook butt.— *Length of the scarph*...	3 9	3 9	3 9	3 9	3 9	3 7	...	...	...	3 3	A
The number of strakes is reduced one less forward and aft, and thickness to.................	0 6	0 6	0 5	0 5	0 5	0 5	0 4	0 3	0 3	0 3	B
Preserving their proper thickness from the extremes..	12 0	11 0	10 0	9 0	9 0	9 0	9 0	9 0	9 0	8 0	C
STUFF between the Lower-deck clamps and Orlop...*thick*	0 6	0 5½	0 5	0 5	0 4½	0 4	0 4	0 4	0 4	0 3	D
Opening between for air...................... *deep*	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 3	E
DECK HOOK—To be *sided*.................................	1 3	1 2½	1 2	1 2	1 1	1 0½	1 0	1 0	1 0	0 11	F
length.................................	20 0	19 6	19 0	19 0	18 0	17 0	16 6	16 0	16 0	16 0	G
Bolted with bolts, in *number*	15	15	13	13	13	13	11	11	11	11	H
diameter......................	0 1½	0 1½	0 1⅜	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	I
The deck to be moulded as broad as it can be gotten for the better fastening the deck plank, (The hook may be assisted by ekeings behind it, and the arms tabled to it, the hook and ekeings to be fayed home to the timbers.)											
BEAMS.—Height of the upperside of the Gun or Lower-deck plank, at the middle line from the upper edge of the rabbet of the Keel .... *afore*....	27 0	25 3	26 9	24 6	23 3	21 2	17 0	17 2	16 8	16 0	K
midships	25 6	23 8	24 4	22 6	21 9	20 0	15 10	16 2	15 9	14 9	L
abaft....	27 7	26 2	26 9	24 6	23 9	22 2	18 6	18 6	17 11	17 0	M
Lower-deck plank..........................*thick*	0 4	0 4	0 4	0 4	0 4	0 4	0 3	0 3	0 3	0 3	N
Height from the upperside of the Gun or Lower-deck plank to the underside of the deck plank above at middle line.................... *afore*....	7 2	7 2	7 2	7 2	7 0	6 9	6 3	6 2	6 2	6 0	O
midships	7 2	7 1	7 1	7 2	7 0	6 9	6 3	6 2	6 2	6 0	P
abaft....	7 2	7 1	7 1	7 2	7 0	6 9	6 3	6 2	6 2	6 0	Q
Beams to round up in midships.....................	0 6	0 6	0 6	0 6	0 5	0 5	0 4½	0 4½	0 4½	0 4	R
Height from the upperside of the Deck-plank to the upperside of the lower sills..................	2 4	2 4	2 4	2 4	2 4	2 4					
Port Sills.........*Lower sills, deep*..................	0 8	0 8	0 7½	0 7½	0 7	0 7					
Upper sills, deep..................	0 7	0 7	0 6	0 6	0 6	0 6					
The upper sills in two-deck ships in wake of the channels, to be 11 inches deep, to receive the preventer bolts. Lower sill to be put in with a bill and the upper sills with a tail.											
Ports—*deep*...	2 9	2 9	2 11	2 9	2 8	2 7					
Fore and aft................................	3 5	3 5	3 5	3 5	3 4	3 3					
Foreside of the foremost port, abaft the foremost perpendicular..................................	11 3	11 3	6 8	18 3	16 8	17 8					
Aftside of the afterport, afore the after perpendicular..	12 1	16 6	10 9	10 8	13 0	13 1					
In distance from port to port......................	7 9	7 9	7 6	7 6	6 9	7 10					
In number..	32	30	32	28	26	22					
Weight of metal intended to carry ..... *pounders*	36	36	42	36	28	28					
*** *The after and foremost port incloses one or two inches by thwartship lines, according to their situation in the turn of the body.*											
Beams in the midships.—*To be sided*.............	1 6	1 5	1 5	1 4	1 3¼	1 2½	1 0	0 11	0 10	0 9½	S
moulded..........	1 6	1 5	1 4	1 4	1 3	1 2	0 11	0 10	0 10	0 9	T
The fourth beam from forward, and the fourth beam from aft to be	1 5	1 4	1 3½	1 3	1 3	1 2	0 10½	0 9¾	0 9¾	...	U
The third beam from forward, and the third beam from aft	1 4½	1 3¾	1 3	1 2¾	1 2¼	1 1½	0 9¾	0 9½	0 9½	...	X

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	3 2	3 0	3 0	The lips of the scarphs are secured by a ¾-inch bolt driven through the middle downwards.														
B	0 3	0 3	0 3	...	...	...	0 2½	0 2½	0 4	0 4	0 4	0 3	0 3	0 3				
C	8 0	7 0	7 0	...	...	...	6 0	6 0	9 0	9 0	9 0	8 0	8 0	7 0				
D	0 3	0 3	(or middle bands in merchant ships)					...	0 4	0 4	0 4	0 3½	0 3	0 3				
E	0 3	0 3	0 2	...	...	...	...	...	As required.									
F	0 10	0 9½	0 9	...	...	...	0 8	0 8	1 2	1 2	1 1	1 0	0 11	0 10	...	...	0 9	
G	15 0	14 0	13 0	...	...	...	11 0	10 6	18 0	17 6	17 0	15 0	14 0	13 0	...	...	12 0	
H	11	11	11	...	...	...	9	9	13	13	13	11	11	9	...	...	9	
I	0 1⅛	0 1⅛	0 1	...	...	...	0 0⅞	0 0⅞	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1⅛	0 1	...	...	0 1	
K	14 9	13 9	10 10	...	...	...	10 0	8 6	21 5	19 2	18 9	17 6	15 6	15 0	...	...	12 7	
L	13 4	12 5	10 0	...	...	...	8 7	7 0	19 5	17 2	17 2	17 2	14 2	14 0	...	...	11 3	
M	15 4	14 9	10 6	...	...	...	11 9	7 7	22 2	20 0	19 10	19 0	16 1	15 9	...	...	13 8	
N	0 2½	0 2½	0 2	...	...	...	0 2	0 2	0 3	0 3	0 3	0 3	0 3	0 2½	...	...	0 2½	
O	5 11	5 10	5 7	...	...	...	5 9	5 7	6 6	7 0	6 2	6 6	6 0	6 1	...	...	4 10	
P	5 11	5 10	5 7	...	...	...	5 9	5 7	6 6	7 0	6 2	6 6	6 0	6 1	...	...	4 10	
Q	5 11	5 10	5 7	...	...	...	6 2	6 0	6 6	7 0	6 2	6 6	6 0	6 1	...	...	6 6	
R	0 4	0 4	0 3	...	...	...	0 3	0 2½	0 6	0 6	0 5	0 5	0 5	0 4	...	...	0 6	
S	0 9½	0 9	0 9	...	...	...	0 8	0 7½	1 2½	1 2¼	1 2	1 1	1 0½	1 0	...	...	0 11	
T	0 8½	0 8	0 7½	...	...	...	0 7	0 7	1 1½	1 1	1 0½	0 11¾	0 11½	0 11¼	...	...	0 8	
U	...	...	...	...	...	...	...	...	1 2	1 1½	1 1	1 0½	0 11½	0 11				
X	...	...	...	...	...	...	...	...	1 1½	1 1	1 0½	1 0	0 11	0 10½				

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
GUN OR LOWER DECK—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	—
The second beam from forward, and the second beam from aft	1 4	1 3¼	1 2½	1 2½	1 1¾	1 1	0 9½	0 9½	0 9½	...	A
The first beam from forward, and the first beam from aft	1 3	1 2¼	1 2	1 2	1 1	1 0½	0 9½	0 9½	0 9½	...	B
Beams, *in number*	29	28	30	27	27	23	28	27	26	26	C
Asunder about	...	...	...	...	...	...	...	...	...	...	D
Beam next afore the Main Mast, to be *sided*	...	...	...	...	...	...	...	...	...	...	E
moulded	...	...	...	...	...	...	...	...	...	...	F
Beam in the Main Hatch, to have double arms, and in wake of the Fore Mast single arm: *deep*	1 5	1 4	1 3½	1 3	1 2	1 1	0 10	0 9	0 9	0 8½	G
moulded	1 4	1 3	1 2½	1 2	1 1	1 0	0 11	0 11	0 10½	0 10	H
The arms to be scarphed and tabled. *Scarphs long*	11 6	10 6	10 0	9 6	9 0	9 0	7 9	7 9	7 6	7 3	I
Bolts in each arm, *in number*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*six*	*six*	*six*	*six*	K
Square iron, *diameter*	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 0⅞	L
Beams made in four pieces, the middle pieces and arms each to be 3-7ths of the whole length of the beam. Beam made											M
be one-third the length of the beam each.											
The scarphs to be tabled, and the lips in thickness when fayed	0 3½	0 3½	0 3	0 3	0 3	0 2¾	0 2½	0 2½	0 2½	0 2¼	N
Bolts through each scarph, *number*	*ten*	*ten*	*eight*	*eight*	*eight*	*eight*	*six*	*six*	*six*	*six*	O
Square iron, *diameter*	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 0⅞	P
Ends of the beams reduced so as to let down upon the Clamp	0 2½	0 2½	0 2½	0 2½	0 2¼	0 2¼	0 2⅛	0 2	0 2	0 1¾	Q
KNEES.—The gun or lower deck beams to be knee'd at each end, with one Hanging and one Lodging Knee. Sloops of 18 guns,											R
Beams; the beams knee'd with Lodging Knees only. Merchant Ships have Iron Hanging Knees, or Dagger Knees, if											S
Hanging Knees *Sided*	0 11½	0 11¼	0 11⅛	0 11	0 10½	0 10	0 9	0 8½	0 8¼	0 8	T
Hanging Arms *length*	6 6	6 4	6 3	6 2	5 9	5 6	5 0	4 10	4 9	4 9	U
Thwartship Arms *length*	5 0	4 9	4 6	4 6	4 4	4 2	3 9	3 8	3 8	3 8	X
Bolts, *in number*	*nine*	*nine*	*nine*	*nine*	*nine*	*nine*	*eight*	*eight*	*eight*	*eight*	Y
diameter	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	Z
If Iron Hanging Knees *, each to weigh about *cwt.*	4 0 0	3 3 0	3 3 0	3 3 0	3 2 0	3 1 0	2 3 0	2 2 0	2 1 0	2 0 0	A
LODGING KNEES.—The Lodging Knees, *sided*	0 11	0 10¾	0 10¼	0 10	0 9½	0 9	0 8½	0 8	0 7½	0 7	B
Thwartship Arm, *in length*	5 4	5 2	5 2	5 2	5 0	4 9	4 6	4 3	4 0	3 9	C
Fore and aft to be the whole length between the beams, if to be had, or length sufficient for not less than bolts, *in number*	*five*	*five*	*four*	*four*	*four*	*four*	*four*	*three*	*three*	*three*	D
Each Lodging Knee to have bolts, or more, *in number*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*seven*	*seven*	*seven*	E
and diameter	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	F
Lodging and Dagger Knees to have a coak left in the end of 1¼ inch long, with the long grain, or a tail when the grain											G
Beam arm to have a coping let into the beam.											
Iron Lodging Knees are each to weigh, when the arms are of an equal length	3 2 0	3 1 0	3 0 0	3 0 0	2 3 0	2 3 0	2 2 0	2 1 0	2 0 0	1 3 0	H
When space between the rooms will not admit of two Lodging Knees of wood, to lock into each other, an Iron Lodging											I
the Riders. Of Lodging Knees of Iron, the beam arm, generally have Iron Plates behind them, as Hanging Knees.—Let											K
of both Knees, be driven the contrary way alternately.											
CENTRES OF MASTS.—The centre of the Foremast abaft the foremost perpendicular	21 0	20 3	20 4	19 6	17 9	16 1½	18 0	15 6	15 10	14 9	L
Rake aft, in every yard in the length	0 0⅛	0 0⅛	0 0 1/16	0 0⅛	0 0⅛	0 0⅛	0 0 1/16	0 0 1/16	0 0 1/16	0 0 1/16	M
The centre of the Main Mast abaft the foremost perpendicular	104 8	103 0	103 2	99 6	89 3	92 0	85 0	83 0	77 0	73 9	N
Rake aft in every yard	0 1	0 1	0 1⅛	0 1	0 1	0 1	0 0⅝	0 0⅝	0 0⅝	0 0⅝	O
The centre of the Mizen Mast afore the after perpendicular	31 0	30 0	23 6	27 3	25 6	23 0	22 6	22 3	20 9	19 0	P
Rake aft, in every yard in the length	0 1½	0 1½	0 1	0 1	0 1½	0 1½	0 1	0 1	0 1	0 1	Q
Bowsprits to stive upwards, in a yard in length	1 5	1 4	1 4	1 4	1 4	1 4	1 3	1 3	1 3	1 3	R

* It is necessary to have Iron Hanging Knees forward and aft when the sudden turn of the body makes against the growth of Wood Knees. Square plates of iron are let into the beams behind all Iron Knees, to take a bolt through the second hole from the side. These iron plates are about 4½ inches broad, 6½ inches long, and 1 inch thick, in large, and proportionally less in smaller ships. See Midships Sections Plate 8. N. B. The Hanging Arms to be carefully disposed clear of Standards, Riders, &c.——GENERAL PROPORTIONS for all IRON KNEES, &c. The shoulders

SCANTLINGS OF SHIPS OF EACH CLASS.

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
A	...	...	...	...	...	...	...	...	1 1	1 0½	1 0	0 11½	0 10½	0 10				
B	...	...	...	...	...	...	...	...	1 0	1 0	1 0	0 11	0 10	0 9½				
C	24	22	21	...	...	...	17	16	26	26	24	22	20	19				
D	...	...	...	...	...	...	...	...	4 8	4 8	4 6	4 6	4 9	4 7				
E	...	...	...	...	...	...	...	...	1 4	1 3½	1 3	1 2	1 1					
F	...	...	...	...	...	...	...	...	1 2	1 2	1 1	1 0½	1 0					
G	0 8	0 7½	0 7	...	...	...	...	...	1 0	1 0	0 11	0 10½	0 10	0 9½				
H	0 10	0 9	0 8½	...	...	...	...	...	1 1	1 1	1 0	0 11	0 10	0 10				
I	7 0	7 0	6 9	...	...	...	...	...	9 0	9 0	8 0	7 6	7 0	6 9				
K	*six*	*six*	*six*	...	...	...	...	...	*eight*	*eight*	*six*	*six*	*six*	*six*				
L	0 0⅞	0 0⅞	0 0¾	...	...	...	...	...	0 1⅛	0 1⅛	0 1⅛	0 0⅞	0 0⅞	0 0¾				
M	in three pieces, the middle piece to be one-half the whole length of the beam; and beams made in two pieces, the scarphs to																	
N	0 2¼	0 2⅛	0 2	...	...	...	...	...	0 2½	0 2½	0 2½	0 2¼	0 2¼	0 2				
O	*six*	*six*	*six*	...	...	...	...	...	*eight*	*eight*	*six*	*six*	*six*	*six*				
P	0 0⅞	0 0⅞	0 0¾	...	...	...	...	...	0 1⅛	0 1⅛	0 1⅛	0 1	0 0⅞	0 0¾				
Q	0 1½	0 1½	0 1¼	...	...	...	...	...	0 2	0 2	0 1¾	0 1½	0 1¼	0 1⅛				
R	and under, have Hanging and Lodging Knees only to the first and second beam afore and abaft the Main Mast, and Fore Hatchway																	
S	of wood, sometimes about 12 beams in Midships have hanging Knees.																	
T	0 7½	0 6¾	0 6	To have one bolt			0 5½	0 5¼	0 9	0 9	0 9	0 7½	0 6½	0 6	...	...	0 6	
U	4 7	4 7	4 6	more in the Hang-			4 0	4 0	4 4	4 3	4 2	4 0	3 10	3 9	...	...	3 6	
X	3 6	3 4	3 0	ing Arm............			3 0	3 0	3 9	3 9	3 9	3 7	3 6	3 3	...	...	3 0	
Y	*seven*	*seven*	*seven*	Foremost and after			*six*	*six*	*nine*	*nine*	*seven*	*seven*	*seven*	*six*	...	...	*six*	
Z	0 1	0 1	0 0⅞	Knees to have one			0 0¾	0 0¾	0 1⅜	0 1⅜	0 1¼	0 1⅛	0 1⅛	0 1	...	...	0 1	
				bolt less. One of the bolts in Merchant ships to be an eye-bolt.														
A	1 3 14	1 3 0	1 2 0	...	...	...	...	...	2 3 0	2 2 0	2 1 0	2 0 14	2 0 0	1 3 0				
B	0 6½	0 6	0 5½	...	...	...	0 5	0 4¾	0 10	0 9½	0 9	0 7½	0 6	0 5½				
C	3 7	3 7	3 6	...	...	...	3 0	3 0	4 3	4 3	4 3	4 0	3 9	3 6				
D	*three*	*three*	*three*	...	...	...	*three*	*three*	*four*	*four*	*three*	*three*	*three*	*three*				
E	*six*	*six*	*six*	...	...	...	*six*	*six*	*seven*	*seven*	*six*	*six*	*six*	*six*				
F	0 1	0 1	0 0⅞	...	...	...	0 0¾	0 0¾	0 1⅜	0 1⅜	0 1¼	0 1⅛	0 1⅛	0 1				
G	will not admit of a coak. This coak, or tail, is to be closely fayed to the side of the beam, and an iron key driven by the sides.																	
H	1 2 0	1 1 14	1 1 0	...	...	...	...	...	2 2 0	2 1 0	2 0 14	1 3 0	1 2 0	1 1 0				
I	Knee is to be fixed that shall fay upon the Wood Lodging Knee, and bolt through both.—Iron Lodging Knees to be fixed behind																	
K	the holes for the bolts be always bored as square to the Knees as possible, and that the fore and aft bolts, which go through the arms																	
			upper deck	*upper deck*	*upper deck*	*upper deck*	*upper deck*											
L	13 6	13 3	13 0	14 8	10 0	12 8	13 2	...	25 3	23 0	22 0	18 10	18 2	17 0	13 0	14 6	11 9	
M	0 0 1/16	0 0 1/16	0 0⅛	0 0⅛	0 0⅛	0 0⅛	0 0⅛	...	Perpendicular			...	...	...	...	0 3		
N	68 3	64 9	62 0	55 0	55 9	50 3	62 0	27 9	90 6	89 9	80 6	70 9	65 9	59 9	49 9	42 4	46 6	19 10
O	0 0⅝	0 0⅝	0 0¾	0 0½	0 0⅝	0 1	0 0½	0 1½	Perpendicular			...	...	...	0 0¼	0 3¾	0 0¼	0 1
P	17 3	16 6	15 0	13 3	12 2	...	...	...	27 0	24 6	24 0	18 0	19 9	14 9				
Q	0 1	0 1	0 1⅛	0 1⅛	0 1	...	...	...	Perpendicular			...	0 0 1/16	0 1				
R	1 2½	1 2½	1 2	1 1	1 3	0 9	0 9	0 7	1 4	1 5	1 5	1 3	1 0	1 6	0 8	0 5	1 0	0 5

or return to be four times in substance the diameter of its bolt, and the breadth of the iron about ¼ of an inch less.. In fastening Hanging Knees place the two upper bolts as high in the throat as possible, the lower bolt full the siding of the Knee from the end, and the intermediate bolts equally between.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
Gun or Lower Deck—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Mast Partners*—To have two Carlings for the partners of the Main-mast … *broad*	1 9	1 8	1 7	1 6	1 5	1 5	1 4	1 3	1 3	1 2	A
deep.	1 8	1 7	1 6	1 5	1 4	1 4	1 3	1 2	1 2	1 1	B
Asunder in the clear equally from the middle line	4 3	4 2	4 1	4 0	3 10	3 9	3 6	3 4	3 4	3 2	C
Uppersides above the beam	0 9	0 9	0 9	0 9	0 8	0 8	0 7	0 6½	0 6½	0 6	D
To have Cross-chocks, in thickness	0 9	0 9	0 9	0 9	0 8	0 8	0 7	0 6	0 6	0 6	E
Pump-carlings to be kept without Mast-carlings	1 4	1 4	1 4	1 4	1 4	1 4	1 4	1 4	1 4	1 4	F
Foremast Partners—Of two Carlings … *broad*	1 6	1 5	1 4	1 4	1 3	1 2	1 1	1 1	1 1	1 1	G
deep	0 11	0 11	0 10	0 10	0 9	0 9	1 0	1 0	1 0	1 0	H
Let down below the upperside of the beam	0 2	0 2	0 1½	0 1½	0 1½	0 1½	0 1	0 1	0 1	0 1	I
Foremast Partners, *asunder in the clear*	4 1	4 0	3 10	3 10	3 8	3 7	3 4	3 2	3 0	3 0	K
Cross-chocks to be thick	0 8	0 8	0 8	0 8	0 7	0 7	0 6	0 6	0 6	0 6	L
Fore and Main-mast Carlings bolted with bolts in diameter	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	M
Wedges—*thick*	0 5	0 5	0 5	0 5	0 5	0 5	0 4½	0 4½	0 4½	0 4	N
The Cross-chocks are bolted with four bolts in each … *diameter*	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	O
Corner chocks are bolted with four bolts in each, *diameter*	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅝	0 0⅝	0 0⅝	0 0⅝	P
Mizen Partners.—To be *thick*	0 8	0 7½	0 7	0 6½	0 6	0 6	0 5	0 5	0 5	0 5	Q
broad	4 2	4 0	3 10	3 10	3 9	3 9	3 6	3 6	3 6	3 4	R
Let down upon the beams	0 1½	0 1½	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	S
Diameters of Fore-mast, at the partners	2 10½	2 9½	2 7⅞	2 8¾	2 5¾	2 2⅜	1 11⅝	1 11⅝	1 11⅜	1 10	T
Diameters of Main-mast, ditto	3 3	3 1¼	2 11⅝	3 1	2 9½	2 5	2 2¼	2 3	2 2	2 0¾	U
Diameters of Mizen-mast, ditto	1 11	1 10¼	1 9⅛	1 10¼	1 7¾	1 7⅜	1 5⅞	1 6⅛	1 5¾	1 5	X
Bowsprit, at the bed	3 1	2 11½	2 10	2 9	2 7½	2 5	2 2¼	2 3	2 2	2 1	Y
Mizen Step (the laps to extend to the farther side of the beams … *to be sided*	1 10	1 9	1 8	1 8	1 8	1 7	1 7	1 7	1 7	1 6	Z
… *deep*	1 8	1 7	1 6	1 6	1 6	1 6	1 6	1 6	1 6	1 5	A
Carling under the Step, let upwards under the beams to the Step … *sided*	The Carling in the hold is continued forward						1 7	1 7	1 7	1 6	B
deep	to the foreside of the Step.						1 2	1 1	1 0	0 11	C
The Step lets down on the beam afore and abaft the mast's centre	0 2½	0 2½	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	D
The Carling and Step are bolted together with bolts, in *number*	*six*	*six*	*six*	*six*	*six*	*six*	*four*	*four*	*four*	*four*	E
diameter	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	F
To have one pillar under each end of the Step—*square* … *at the head*	0 11	0 11	0 11	0 11	0 10	0 10	0 8	0 8	0 8	0 8	G
at the heel	1 0	1 0	1 0	1 0	0 11	0 11	0 9	0 9	0 9	0 9	H
									Upper deck in		I
Bowsprit Step.—To be in *number of pieces*	*three*	*three*	*three*	*2 or 3*	*two*	*two*	*two*	*two*	*two*	*two*	K
thick	1 2	1 2	1 1	1 1	1 0	0 11	0 10	0 10	0 10	0 10	L
Out to outside—in *breadth*	4 8	4 6	4 4	4 2	4 0	3 10	3 8	3 8	3 6	3 6	M
Rabbetted together, and bolted athwartships with three bolts, *diameter*	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	N
To extend from the underside of the beam at the lower end to upperside of beam above … Bolts through beam, *diameter*	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 1	O
to be let aft.	0 3	0 3	0 2½	0 2½	0 2½	0 2	0 2	0 2	0 2	0 2	P
When formed by chocks. The chocks to be *broad*	Equally placed from the centre of the heeling, and let aft into rabbets up-										Q
Lap on from the foreside, and to be *thick*	on the bitts 1-3 through their thickness.										R
Hatchways.—The Main Hatchway … *fore and aft*	9 0	8 9	8 6	8 6	8 4	7 9	7 9	7 6	7 6	6 9	S
thwartships	7 0	6 9	6 6	6 4	6 0	5 9	5 9	5 9	5 6	5 3	T
Aftside, afore the centre of the main-mast	5 8	5 8	5 9	6 0	5 3	3 8	4 6	4 6	4 0	3 6	U
Fore Hatchway … *fore and aft*	5 3	4 9	4 9	4 9	4 8	4 8	4 8	4 8	4 8	4 8	X
thwartships	5 2	5 0	4 9	4 9	4 8	4 8	4 8	4 8	4 6	4 6	Y
Foreside of it abaft the centre of the foremast	32 0	28 3	35 3	32 3	25 3	25 9	27 6	27 3	26 0	23 9	Z
After Hatchway … *fore and aft*	4 8	4 8	4 8	4 8	4 8	4 8	4 8	4 8	4 8	4 8	A
thwartships	5 2	5 0	4 9	4 8	4 8	4 8	4 8	4 6	4 3	4 0	B

* The most general rule to frame the mast partners is, to space the carlings by consulting the diameter of the mast and the thickness of the wedging. The fore part of the after cross-chock may then be let down half the distance the carlings are asunder abaft the centre of the mast, and the aftside of the foremost cross-chock the same afore the mast's centre, adding the thickness of the front fish, if any. The cross-chocks are rabbetted half their thickness on the carlings, and left up to round about one inch in their length. The aft part of the mast hole is then eight squared, and corner-

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	1 1	1 0	3 6	Plank	The Carlings to be let				1 4	1 4	1 2	1 1	3 4	3 0	Plank	...	0 8	
B	1 0	0 11	0 4		down carling-fashion, and				1 3	1 3	1 0	1 0	0 4	0 4	...	...	0 10	
C	3 0	2 9	...		the laps to extend to the				3 7	3 6	3 5	3 0	...	...	...	...	2 4	
D	0 5	0 5	0 3		farther sides of the beams.				0 6	0 6	0 5	0 5	...	...	...	...	0 4	
E	0 5	0 5	...	...	...	...	...	...	0 6	0 6	0 5	0 5	...	...	...	...	0 4	
F	1 4	1 4	1 4	...	...	...	...	...	1 4	1 4	1 4	1 4	...	...	...	...	1 2	
G	1 0	0 11	3 3	Standards to the foremost bitts					1 3	1 2	1 1	0 11	3 0	2 9	...	...	0 8	
H	0 11	0 10	0 4	make the upper part of the part-					1 2	1 1	1 0	0 10	0 4	0 4	...	...	0 10	
I	0 1	0 1	0 1	ners, and take the cross-chocks.					0 1½	0 1½	0 1¼	0 1	0 1	0 1	...	...	...	0 1
K	2 10	2 7	...	...	...	...	...	...	3 5	3 4	3 3	2 10						
L	0 5	0 5	...	...	...	...	...	...	0 6	0 6	0 5	0 5						
M	0 0⅞	0 0⅞	0 0¾	Through the beam, two in each lap.					0 1⅛	0 1⅛	0 1	0 0⅞	0 0¾	0 0¾				
N	0 4	0 4	...	...	...	...	...	...	0 4	0 4	0 4	0 3½						
O	0 0¾	0 0¾																
P	0 0⅝	0 0⅝																
Q	0 5	0 4	0 3½	Mizen-masts, in general, of				...	0 5	0 4	0 3½	0 3½	0 3	0 3	...	...	0 3	
R	3 2	3 0	2 9	late years, step upon the				...	3 6	3 6	3 4	3 2	3 0	2 9	...	...	2 4	
S	0 1	0 1	0 0¾	Lower-deck.				...	0 1	0 1	0 0¾	0 0¾	0 0⅝	0 0⅝	...	...	0 0⅝	
T	1 8⅞	1 7½	See Steel's "*Art of Mast Making*," &c.															
U	1 11⅝	1 10¼																
X	1 4¾	1 3																
Y	1 11⅝	2 10¼																
Z	1 5	1 4	1 2	1 1	1 2	In large merchant ships			1 5	1 5	1 4	1 3	1 2	1 1				
A	1 4	1 3	1 2	1 0	1 0	the step runs aft to the			1 0	1 0	1 0	1 2	1 1	1 0				
B	1 5	1 4	1 2	1 1	1 2	post; it is 12 inches			1 5	1 5	1 4	1 3	1 2	1 1				
C	0 11	0 10½	0 10	0 9	0 10	square abaft the step-ping, and hances to it.			0 11	0 11	0 10	0 10	0 9	0 9				
D	0 2	0 2	0 1½	0 1½	0 1½	...	...	...	0 2	0 2	0 2	0 2	0 1½	0 1½				
E	*four*	*four*	*four*	*four*	*four*	...	...	...	*four*	*four*	*four*	*four*	*four*	*four*				
F	0 1	0 1	0 1	0 0⅞	0 1	...	...	...	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 0⅞				
G	0 7	0 7	0 7	0 6	0 7	...	...	...	0 10	0 10	0 9	0 8	0 7	0 6				
H	0 8	0 8	0 8	0 7	0 8	...	...	...	0 11	0 11	0 10	0 9	0 8	0 7				
I	frigates and under.								Middle deck of India ships.									
K	*two*	*two*	*two*	*two*	*two*	In some ships the out-			*two*	*two*	*two*	*two*	*two*	*two*				
L	0 9	0 9	0 8	0 7	0 8	sides are square, and			1 0	1 0	0 11	0 9	0 9	0 8				
M	3 8	3 8	3 8	3 4	3 6	run up high enough above the forecastle to			3 4	3 4	3 2	3 8	3 6	3 4				
N	0 1	0 1	0 0¾	0 0¾	0 0¾	make topsail sheet-bitts. The step is form-			0 1¼	0 1¼	0 1⅛	0 0⅞	0 0¾	0 0¾	Made by the bitts upon deck.			
O	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	ed by chocks.			0 1⅛	0 1⅛	0 1	0 0¾	0 0¾	0 0¾				
P	0 1½	0 1½	0 1¼	0 1¼	0 1¼	...	...	...	0 2	0 2	0 2	0 1½	0 1½	0 1¼				
Q	...	1 8	1 7	1 3	1 6	...	...	...	...	...	...	1 7	1 6	1 4				
R	...	0 7½	0 7	0 5	0 7	...	...	...	...	...	...	0 7	0 6	0 6				
S	6 6	6 0	5 9	4 9	...	5 0	5 3	5 7	7 0	7 0	7 0	7 4	7 4	7 4	...	...	7 6	
T	5 2	5 0	4 6	3 9	...	4 6	4 6	4 8	5 6	5 6	5 6	5 4	5 4	5 4	...	...	7 0	
U	3 4	3 4	3 3	3 0	...	2 9	6 8	...	4 4	4 0	3 6	4 1	3 4	3 2	...	...	4 7	
X	4 6	4 4	4 0	4 0	...	4 2	3 6	4 2	4 6	4 6	4 6	4 6	4 6	4 6	...	...	4 0	
Y	4 4	4 4	4 2	3 10	...	4 0	3 8	4 0	4 4	4 4	4 4	4 4	4 6	4 4	...	...	4 4	
Z	22 0	20 0	12 0	11 9	...	8 6	6 11	...	20 6	20 0	19 6	9 4	12 4	...	...	...	9 10	
A	4 6	4 4	4 0	...	...	2 10	2 8	2 4	4 6	4 6	4 6	4 6	4 6	...	...	...	2 9	
B	3 10	3 10	3 10	...	...	4 0	4 0	4 0	4 4	4 4	4 4	4 4	4 4	...	...	...	3 8	

chocks rabbetted on to the carlings, and cross-chocks, but faced on only half the thickness of corner-chocks upon the cross-chocks. The corner-chocks at the forepart of the mast hole are rabbetted on in the same manner as the after-chocks. Corner-chocks to be of the same thickness as the cross-chocks. N. B. When mast holes are cut circular, there is no confinement to the breadth of the wedges.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
GUN OR LOWER DECK—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
HATCHWAYS.—Fore side of it abaft the centre of the Main Mast	7 3	6 0	7 0	6 6	5 3	5 9	4 9	4 6	4 3	4 3	A
LADDER-WAYS.—To have a ladderway to the fore platform next before the fore hatchway — *fore and aft*	3 2	3 0	3 6	3 0	2 9	2 9	2 4	2 4	2 4	2 4	B
thwartships	5 0	5 0	4 9	4 9	4 8	4 8	4 8	4 8	4 6	4 6	C
To have a ladderway to steward room afore the after bulkhead of the cockpit — *fore and aft*	3 6	3 6	3 9	3 6	3 6	3 0	3 4	3 4	3 4	3 4	D
thwartships	5 0	5 0	4 9	4 9	4 8	4 8	4 8	4 8	4 6	4 6	E
HATCHES.—To have a hatch over the spirit room-hatch — *fore and aft*	4 8	4 8	4 8	4 7	4 6	4 6	4 0	4 0	3 9	3 9	F
thwartships	5 0	5 0	4 9	4 8	4 8	4 8	4 8	4 8	4 8	4 6	G
To have a hatch the aftside of it afore the foremast											
fore and aft.											
thwartships.											
SCUTTLES.—To frame a cap-scuttle near to the middle line, one on each side afore each riding bitt — *square in the clear*	2 4	2 4	2 2	2 0	2 0	2 0	...	...	...	...	H
plank	0 4	0 4	0 4	0 4	0 3	0 3	...	...	...	...	I
Framed together coaming fashion, and *above the deck*	0 7	0 7	0 7	0 7	0 6	0 6	...	...	...	...	K
To frame cap-scuttles similar to those afore the bitts, one over each powder-room passage. *Square in the clear*	2 0	2 0	1 10	1 9	1 8	1 7					
Framing to stand above the deck	0 8	0 8	0 7	0 7	0 6	0 6					
To have a scuttle abaft the Mizen Mast	...	...	...	...	...	...	...	...	...	...	L
fore and aft	...	...	...	...	...	...	...	...	...	...	M
thwartships.											
To have a cap-scuttle over the bread-room, *square*	2 9	2 9	2 9	2 9	2 9	2 9	2 9	2 9	2 9	2 9	N
On the larboard side afore the second beam in Midships, or as near as the standard will admit framing above the deck	0 8	0 8	0 7	0 7	0 6	0 6					
And another cap-scuttle of the same height above the deck, on the starboard side, over Lady's-hole, as near the Midships as the standard will admit. *Scuttle square in the clear*	2 0	2 0	2 0	2 0	1 10	1 10	...	...	...	...	O
CARLINGS — Number of tiers on each side — *from*	*four*	*four*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	P
to	*three*	*three*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	Q
Carlings to be oak, for frigates and small vessels may be fir — *broad*	0 11½	0 10½	0 10	0 9	0 8½	0 8	0 7½	0 7	0 7	0 6½	R
deep	0 10½	0 9½	0 9	0 8½	0 8	0 7½	0 7	0 6½	0 6½	0 5½	S
Scored on upon the beams aloft, and ⅛ of an inch less allow	0 1½	0 1½	0 1½	0 1½	0 1½	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	T
In some Merchant Ships, the lower deck Carlings and Ledges are framed so as to be unshipt occasionally, as far forward as											U
standards to the bitts, and bows to receive the scores of the ledges, without the standards; and the Carlings that frame											X
LEDGES.—In the clear asunder not more than 12 inches, nor less than 9 inches — *broad*	0 6	0 6	0 6	0 5½	0 5½	0 5	0 4½	0 4	0 4	0 4	Y
deep.	0 5	0 5	0 5	0 5	0 5	0 4½	0 4	0 3½	0 3½	0 3½	Z
COAMINGS.—To have coamings to the hatch and ladderways in 1 whole length, and bearded from the deck upwards — *upper side above the deck*	1 8	1 8	1 6	1 6	1 6	1 6	0 4	0 4	0 4	0 3	A
broad upon the beam	0 9	0 8½	0 8	0 8	0 7½	0 7	0 7	0 7	0 7	0 7	B
upon the upper side	0 8	0 7½	0 7	0 7	0 6½	0 6	To beard back 1¼ inch.				C
HEAD-LEDGES.—To be thick	0 8	0 7½	0 7	0 7	0 6½	0 6	Framed as the coamings above.				
Deep as the coamings at the sides, and round up more than the beam in its length	0 3	0 3	0 2½	0 2½	0 2	0 2					
The coamings and head-ledges to be lap'd together at the ends so as to strengthen each way, and the coamings tail'd ¾ of an											D
The head-ledges to be bolted through the beams in the middle, and the coamings at the laps with bolts, *in diameter*	0 1⅛	0 1	0 1	0 1	0 1	0 1	0 0¾	0 0¾	0 0¾	0 0¾	E
The ladderways to be inclosed with 4 or 3 inch plank, instead of broadhead ledges, broad enough to be flush with the side											F
the sides of the pillar, and a bolt driven on each side of the score to prevent its splitting, of ¾ of an inch *diameter.*											
GRATINGS.—The grating-ledges to be *thick*	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 2½	0 2½	0 2½	G
deep	0 4	0 4	0 4	0 4	0 3½	0 3½	0 3½	0 3	0 3	0 3	H

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	4 3	4 2	4 2	...	...	5 0	5 3	...	14 4	13 6	12 6	8 5	9 3	...	...	...	2 10	
B	2 4	2 2	2 2															
C	4 6	4 4	4 2															
D	3 2	3 2	3 0															
E	4 4	4 4	4 2															
F	3 9	3 7	3 5															
G	4 4	4 2	4 2															
H, I, K	The after cap-scuttle to be afore the after bitts on the larboard side, and the foremost cap-scuttle afore the fore bitts on the starboard side, to be bolted through the beam, or framing with one ¾ inch bolt at each corner. The caps made of 1½ inch deal, and hung from forward with iron horseshoe hinges.																	
L	...	...	...	...	...	...	...	...	...	...	...	6 0						
M	...	...	...	...	...	...	...	...	...	...	...	3 0						
N	2 9	2 9	Only a flat scuttle in frigates, and under.															
O	The caps of both scuttles to be hung from aft with horseshoe hinges.																	
P	*two*	*two*	*two*	Room afore Forehatch to Mizen Mast					*three*	*three*	*three*	*two*	*two*	*two*	...	...	*two*	
Q	*one*	*one*	*one*	Room, thence forward to aft.					*two*	*two*	*two*	*one*	*one*	*one*	...	...	*one*	
R	0 6	0 6	0 6	...	...	...	0 4	0 4	0 9	0 9	0 9	0 8	0 7	0 6	...	...	0 6	
S	0 5	0 5	0 4½	...	...	...	0 3½	0 3¼	0 8	0 8	0 7½	0 7	0 6	0 5	...	...	0 5	
T	0 1⅛	0 1⅛	0 1⅛	...	...	...	0 1	0 1	0 1½	0 1½	0 1¼	0 1¼	0 1⅛	0 1	...	...	0 0⅞	
U	the foremast. The pillars to stand upon the beams, and the deck fitted also to take up. To have Carlings broad enough under the																	
X	the hatchways to be 1½ inch broader than the given size.																	
Y	0 3½	0 3½	0 3½	...	...	...	0 3	0 3	0 6	0 6	0 5½	0 4½	0 4	0 4				
Z	0 3	0 3	0 3	...	...	...	0 2½	0 2½	0 4½	0 4½	0 4	0 3	0 3	0 3				
A	0 3	0 3	0 3	Deep coamings are often made in two, and coaked together.			0 2½	0 2½	0 4	0 4	0 4	0 4	0 3	0 3				
B	0 6	0 6	0 6				0 5	0 4½	0 6	0 6	0 6	0 6	0 5	0 5				
C	...	...	...				0 4½	0 4										
D	inch into the head-ledges, and above the rabbet, about ⅜ of an inch. N. B. The rabbet for the gratings must be taken out first.																	
E	0 0¾	0 0¾	0 0¾	Coamings are treenailed down.														
F	of the beam, cut to the round up of the head-ledge, and let aft or forward in rabbets of the coamings, with a score tailed into																	
G	0 2½	0 2½	0 2½	...	...	...	0 2¼	0 2¼	Hatches.									
H	0 3	0 3	0 3	...	...	...	0 2¾	0 2¾										

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
GUN, OR LOWER DECK—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Grating battens to be 2¼ inches broad, and ¾ thick. The ledges and battens to be of oak, the gratings substantially made, and the opening not more than 2¼ inches square.											
RIDING BITTS.—The Riding Bitts are fixed upon the gun-deck of three and two-decked ships, upon the upper deck of frigates and under, and upon the middle deck of some merchant ships.—Number of pairs	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	A
Heads.. Foremost ones—*square*	1 10	1 9	1 5	1 5	1 5	1 4	1 4	1 4	1 3	1 2	B
Heads.. After ones—*square*	1 11	1 10	1 6	1 5	1 5	1 5	1 5	1 4	1 4	1 3	C
And to continue that size downwards below the beam next their heads	2 0	1 6	1 3	1 0	1 0	1 0	1 0	1 0	1 0	1 0	D
And to taper thence, so as to be at the lower ends	1 3	1 3	1 2	1 2	1 1	1 0	0 11	0 11	0 10	0 10	E
The heads above the deck	5 2	5 2	5 2	5 2	5 0	5 0	5 0	5 0	5 0	4 9	F
The heel of the bitts to run down and step in the footwaling, if required, but lately they have run down no lower in the navy than the underside of the Orlop beam, and a large carling let down against the heel.—To have an oak carling let down upon the lower deck beams for the heels of the Bitts to step on — *deep*	...	...	...	...	...	...	...	...	...	...	G
— *broad*	...	...	...	...	...	...	...	...	...	...	H
— bolted; the bolts in	*number* ...		...	...	...	...	...	...	...	...	I
	diameter ...		...	...	...	...	...	...	...	...	K
The foremost Bitts, which are dog-bitts in India ships — Abaft the foremost perpendicular	31 9	30 9	31 2	31 6	26 3	24 9	19 0	18 9	18 6	18 0	L
— Distant athwartships	4 0	3 10	3 10	3 10	3 9	3 6	3 6	3 5	3 5	3 2	M
The after-bitts, abaft the foreside of the fore-bitts	11 6	11 0	12 0	11 4	10 9	10 9	16 0	16 0	16 0	15 9	N
Distance between the after-bitts athwartships	4 10	4 8	4 6	4 6	4 6	4 3	5 0	5 0	5 0	5 0	O
Each of the bitts to face on upon the aftside of beam	0 2½	0 2½	0 2½	0 2½	0 2¼	0 2¼	0 2	0 2	0 1¾	0 1¾	P
Each bolted to the beam, with two bolts in *diameter*	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	Q
Cleats against the foreside under lower-deck beam *thick*	0 8	0 8	0 7	0 7	0 6	0 6	0 5	0 5	0 5	0 4	R
broad	1 1	1 1	1 0	1 0	1 0	1 0	0 11	0 11	0 11	0 10	S
Cleats to be the whole length, so as to set up tight between the beams, and to fasten to the bitts with two bolts, ¾ of an inch diameter at the upper ends, and nail below. N. B. To fix them clear of the passage doors to the Light-room, &c.											
CROSS PIECES to the Bitts, *fore and aft*	1 8	1 7	1 6	1 5	1 5	1 4	1 4	1 3	1 3	1 2	T
deep	1 6	1 5	1 4	1 3	1 3	1 2	1 2	1 2	1 2	1 1	U
To have elm backs, in *thickness*	0 6	0 6	0 6	0 6	0 6	0 6	0 5	0 5	0 5	0 5	X
The underside of the cross-piece to the fore-bitts above the deck	1 10	1 9	1 9	1 9	1 7	1 6	1 6	1 6	1 6	1 6	Y
The underside of the cross-piece to the after-bitts above the deck	1 9	1 8	1 8	1 8	1 6	1 5	1 7	1 7	1 7	1 7	Z
Ends of the cross-piece to extend without the bitts	2 4	2 4	2 3	2 3	2 3	2 3	2 8	2 8	2 8	2 8	A
Each scored on to the bitts with a facing of	0 2½	0 2½	0 2½	0 2½	0 2	0 2	0 2	0 2	0 2	0 1¾	B
Cross-pieces fastened with an hook and eye bolt on the foreside hook to forelock — Hook, *diameter*	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	C
— Collar head and eye-bolt each, *diameter*	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	D

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	*two*	*two*	*two*	*one*	*one*	*one*	*two*	*one*	*two*	*two*	*two*	*one*	...	...	See Windlass.			
B	1 2	1 1	1 0½	0 9	1 0	0 11	1 0	0 11	1 8	1 7	1 5	1 4	...	...	If no windlass			
C	1 3	1 2	1 1	0 10	...	...	0 10	...	1 9	1 8	1 6	1 5	...	...	to be fitted as			
															the brig-cutter			
D	1 0	0 10	0 9	3 0	1 0	0 9	0 9	0 9	1 6	1 6	1 0	1 0	...	...	in the 17th			
															column.			
E	0 9	0 9	0 9	0 8	0 9	0 7	0 7	0 7	1 4	1 4	1 3	1 2						
F	4 6	4 3	4 1	3 6	3 9	4 4	4 6	4 4	5 0	5 0	5 0	4 9						
G	...	...	...	...	...	...	...	...	1 4	1 4	1 3	1 3						
H	...	...	...	...	...	...	...	...	1 0	1 0	0 11	0 10½						
I	...	...	...	...	...	...	...	...	*four*	*four*	*four*	*four*						
K	...	...	...	...	...	...	...	...	0 1	0 1	0 1	0 0⅞						
L	17 0	15 9	...	...	...	9 6	10 6	9 0	29 0	28 6¼	27 0	22 0						
									Outsides.									
M	3 2	3 1	...	...	...	3 0	3 0	3 0	9 0	9 0	8 9	7 0						
N	14 0	13 0	...	Forem. perpendicular.			5 6	...	11 0	10 9½	10 6	9 6						
									Outsides.									
O	4 10	4 8	4 2	15 0	13 9	....	4 0	...	10 0	10 0	9 9	8 0						
P	0 1¾	0 1½	0 1½	...	...	...	0 1½	...	0 2¼	0 2¼	0 2	0 1½						
Q	0 0⅞	0 0⅞	0 0¾	0 0¾	0 1	0 0¾	0 0¾	0 0¾	0 1¼	0 1¼	0 1⅛	0 1						
R	0 4	0 4	0 4	0 3	0 3	0 3	0 3	0 3	0 6	0 6	0 5	0 4						
S	0 10	0 9	0 9	As the bitts.		...	...	...	0 11	0 11	0 11	0 10						
T	1 2	1 1	1 1	0 10	1 0	0 9½	0 11	0 10	1 6	1 6	1 5	1 2						
U	1 0	0 11	0 10	0 9	0 10	0 8	0 9½	0 8½	2 0	1 10	1 7	1 5						
X	0 5	0 5	0 4	0 4	0 4	0 3½	0 5	0 4										
Y	1 6	1 5	1 4½	1 4	1 0	0 11	1 0	1 0	1 2	1 2	1 2	1 2						
Z	1 7	1 6	...	...	...	...	1 10	...	1 3	1 3	1 3	1 3						
A	2 6	2 4	1 8	1 6	1 6	1 7	1 8	1 7	2 4	2 4	2 4	2 4						
B	0 1¾	0 1⅝	0 1½	0 1¼	0 1½	0 1⅜	0 1½	0 1⅜	0 2	0 2	0 2	0 1¾						
C	0 1⅛	0 1⅛	0 1	0 0⅞	0 1	0 0⅞	0 0⅞	0 0⅞	0 1¼	0 1¼	0 1⅛	0 1⅛						
D	0 1	0 1	0 0⅞	0 0¾	0 0⅞	0 0¾	0 0¾	0 0¾	0 1¼	0 1¼	0 1⅛	0 1⅛						

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
Gun or Lower Deck—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Standards or Spurs against the Bitts. The foremost standards to extend to the beam before the foremast, and cut with a swell on the midship side, to make the foremast partners. Standards to the after bitts continue forward to the aftside of the fore bitts............*Sided*	1 1	1 1	1 0	1 0	1 0	0 11½	0 11½	0 11	0 11	0 10½	A
Let down upon the beams........................	0 2	0 2	0 1¾	0 1½	0 1½	0 1½	0 1¼	0 1¼	0 1¼	0 1¼	B
Bolted through the beams and carlings, bolts *diameter*.........	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	C
To cut holes near the deck through the aft part of each spur, *diameter*.........................	0 5	0 5	0 4	0 4	0 4	0 4	0 3½	0 3½	0 3½	0 3½	D
The upper part of the arms next the bitts to reach as high as the upperside of the cross-piece.											
Standards.—One against the stemson, if required, *sided*	1 2	1 2	1 1	1 1	1 0	1 0	...	...	...	...	E
Faced down upon the beams	0 2½	0 2½	0 2	0 2	0 1¾	0 1¾					
Arm next the stemson, in length..................	6 0	6 0	5 9	5 9	5 7	5 7	...	...	...	...	F
Number of bolts in ditto..........................	*four*	*four*	*four*	*four*	*four*	*four*					
The fore and aft arm of length sufficient to take a bolt through the beam afore the bowsprit partners, and one through the											G
Iron standards against the bows, each to weigh	...	...	...	...	...	...	...	...	...	...	H
Bolts, *in number*.........	One in each beam.			...	...	...	...	...	...	...	I
diameter........	0 1½	0 1⅜	0 1⅜	0 1⅜	0 1¼	0 1¼	...	...	...	...	K
To have a well grown standard fayed against the Transoms.................. *sided*	1 2	1 2	1 1	1 1	1 0	1 0					
scored	0 3	0 3	0 2½	0 2½	0 2	0 2	...	...	...	...	L
The fore and aft arm to be long enough to have a bolt through the third beam from aft (or longer if to be had) the arm											M
If an iron standard, to weigh.....................	...	...	...	...	...	...	...	...	...	...	N
Bolted with one bolt in each beam, and one between, and two bolts through each Transom, or *in number*............	...	...	...	...	...	...	...	...	...	...	O
diameter..........	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1¼	0 1¼	...	...	...	..	P
Partners and Steps of the Capstans.—To frame partners for the fore jear capstan, that it may occasionally be lowered upon											Q
The framing to be carlings...............*broad*.....	0 11	0 11	0 10	0 10	0 10	0 10	...	...	...	...	R
deep......	1 0	1 0	0 11	0 11	0 11	0 11	...	...	...	...	S
Partners...................................*thick*.....	0 8	0 8	0 7	0 7	0 7	0 6					
Each piece next the centre............*broad*.....	2 0	2 0	1 11	1 10	1 9	1 9					
Outer pieces each to be................*broad*.....	1 4	1 3	1 2	1 2	1 1	1 0					
The ends rabbetted on the carlings...............	0 6	0 6	0 6	0 6	0 6	0 5					
To have a shifting step.................*broad*.....	1 9	1 9	1 8	1 8	1 7	1 6	...	...	...	...	T
deep.......	1 7	1 7	1 6	1 6	1 5	1 4	...	...	...	...	U
Or a chock to shift, to be elm..........*square*....	3 6	3 4	3 2	3 0	2 10	2 8	...	...	...	...	X
deep......	1 3	1 2	1 1	1 0	1 0	0 11	...	...	...	...	Y
The ledges...............................*square*.....	0 5	0 4	0 4	0 4	0 3½	0 3½	...	...	...	...	Z
The said chock supported by a pillar, *square*	1 2	1 1	1 0	1 0	1 0	0 11	...	...	...	...	A
To have a temporary step with a tenon into the cup of the Orlop step......... *broad*	1 6	1 5	1 4	1 4	1 4	1 3	...	...	...	...	B
deep	1 5	1 5	1 4	1 4	1 4	1 3	...	...	...	...	C
The partners to be bolted at the ends, *diameter*	0 1⅛	0 1⅛	0 1	0 1	0 1	0 0⅞	...	...	...	...	D
Step for the Main Jear Capstan..............*broad*......	2 0	1 10	1 9	1 9	1 8	1 8	...	...	...	...	E
deep.......	1 10	1 9	1 8	1 8	1 7	1 7	...	...	...	...	F
Upperside to stand above the beam..............	0 8	0 8	0 8	0 8	0 7	0 7	...	...	...	...	G
Bolted through the beams, bolts *in diameter*.....	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	...	...	...	...	H
To have pieces of oak let down upon the beams 1 inch on each side the step, of sufficient breadth to let the pall rim over											I
neath. The pieces to be left with a margin of 2 or 3 inches beyond the pall rim, and then reduced to the thickness of											K
Helm Port Transom.............................*deep*......	0 11	0 11	0 10	0 10	0 9½	0 9½	...	...	...	...	L
Scored aft and bolted to the counter-timbers, bolt *in diameter*.......	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	...	...	...	...	M
To have 2 bolts driven on each side, the cast part of the Transom ....*diameter*......	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	...	...	...	...	N
Moulded, or fore and aft as broad as may be had	1 10	1 10	1 8	1 8	1 9	1 7	...	...	...	...	O
broad upon the clamp	1 6	1 6	1 4	1 4	1 2	1 2	...	...	...	...	P
To the Helm Port Transom............*sided*......	0 10	0 10	0 9	0 9	0 8	0 8	...	...	...	...	Q
Knees.—Fore and aft arm long..............................	11 6	11 0	10 9	10 6	10 3	10 0	...	...	...	...	R

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	0 10	0 $9\frac{1}{2}$	0 9	0 6	0 9	0 $5\frac{1}{2}$	0 6	0 6	1 0	1 0	0 11	0 10						
B	0 $1\frac{1}{8}$	0 $1\frac{1}{8}$	0 1	0 $0\frac{7}{8}$	0 1	0 $0\frac{7}{8}$	0 $0\frac{7}{8}$	0 $0\frac{7}{8}$	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$	0 $1\frac{1}{8}$						
C	0 1	0 1	0 1	0 $0\frac{7}{8}$	0 1	0 $0\frac{3}{4}$	0 $0\frac{7}{8}$	0 $0\frac{7}{8}$	0 $1\frac{1}{8}$	0 $1\frac{1}{8}$	0 $1\frac{1}{8}$	0 1						
D	0 3	0 3	0 $2\frac{3}{4}$	0 $2\frac{1}{2}$	0 3	0 $2\frac{1}{4}$	0 $2\frac{1}{2}$	0 $2\frac{1}{2}$	0 4	0 4	0 $3\frac{1}{2}$	0 $3\frac{1}{4}$						
E	And well grown.																	
F	Or to run up within 2 inches of the underside of the deck-hook above.																	
G	step or breast-hook, there holding all its substance, and thence trance to make good the deck to the bowsprit step.																	
H	...	...	...	...	...	...	...	*cwt.*	3 3 0	3 2 14	3 2 0	3 1 0						
I	...	...	...	...	...	...	...	...	*ten*	*ten*	*ten*	*ten*						
K	...	...	...	...	...	...	...	...	0 $1\frac{3}{8}$	0 $1\frac{3}{8}$	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$						
L	Or faced down upon the beams, and aft against the Transoms.																	
M	against the Transoms to reach to the upper side of the Helm Port Transom.																	
N	...	...	...	...	...	...	...	*cwt.*	5 0 0	4 3 0	4 2 0							
O	...	...	...	...	...	...	...	...	*ten*	*ten*	*ten*							
P	...	...	...	...	...	...	...	...	0 $1\frac{3}{8}$	0 $1\frac{3}{8}$	0 $1\frac{1}{4}$							
Q	the Orlop.																	
R S	Lap'd together at the ends, and tailed each way. To have rabbets taken out of the fore and aft Carlings, with a double stop to receive the ends of the partners.																	
T U	Let down between the beams carling fashion, and left above the beam high enough to make a level surface with the upperside of the partners.																	
X Y	Let up through the partners, with laps underneath, supported with two temporary ledges under it while the pillar is shifted.																	
Z	Their ends chased about into the Carlings to shift when required.																	
A B C	The head of the pillar to be let up $1\frac{1}{4}$ inch to the underside of the chock, and the heel 2 inches into the upperside of the shifting step, from the starboard side; and a batten tailed in and fayed against the heel to prevent its coming out.																	
D	Saucer-headed bolts, 2 in each end, to forelock snugly at the points.																	
E F	To be let down between the beams with a double stop, and the upperside left sufficiently above the beam to let down the pall rim, and answer with the partners above.																	
G	The laps to extend to within 3 inches of the further sides of the beam, so as to receive the deck.																	
H	Two bolts in each lap.																	
I K	and take the bolts, with broad ledges let down under the said pieces in way of the bolts, which come through and forelock under-the deck. The length of those pieces is generally determined by the hatch and ladderways.																	
L M	To be a well grown piece, and to have no more cast than will admit of 3 inches in the clear between the tiller and the undersides of the beams above, and upperside of the Helm Port Transom; that is, 6 inches more than the depth of the tiller.																	
N	And clenched, as the short wood may be apt to spring.																	
O	In the middle, and hanced towards the ends.																	
P	Ends fay close of a length against the side counter-timbers.																	
Q	The Knees to be well grown, little or no chock.																	
R	Let over the Hanging Knees, which should be iron for that reason.																	

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
GUN OR LOWER DECK—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Thwartship Arm, long, *(to coak into the transom)*	6 4	6 3	5 10	5 8	5 6	5 3					
Bolts { *In the fore and aft Arm ....number...*	*seven*	*seven*	*six*	*six*	*six*	*six*					
Bolts { *In the Thwartship Arm ....number...*	*five*	*five*	*four*	*four*	*four*	*four*					
Bolts { *in diameter...*	0 $1\frac{3}{8}$	0 $1\frac{3}{8}$	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$					
WATERWAYS.—The Waterways.....................*thick...*	0 6	0 6	0 6	0 6	0 5	0 5	0 4	0 4	0 4	0 4	A
Broad as may be had clear of sap. Chined down to the thickness of the deck within two inches of the spirketting, and from											B
$\frac{3}{4}$ of an inch. To avoid wounding the riders more for making a better stop, let oak cleats, about three inches thick, be											C
behind the waterways all fore and aft, but dry oak for fillings is now preferred.											
FLAT of the DECK ....*thick...*	0 4	0 4	0 4	0 4	0 4	0 4	0 3	0 3	0 3	0 3	D
Number of strakes of English oak plank next the waterways..	*six*	*six*	*five*	*five*	*five*	*five*	*four*	*four*	*four*	*three*	E
And one next the hatchways..............*thick...*	...	...	...	...	...	...	...	...	...	...	F
Binding-strakes.—Two strakes on each side, to be the third and second strake outside the coamings, are to continue fore and											G
one inch thicker than the deck flat, and let down that inch between the beams, carlings, and ledges. To shut in between											H
strake is one inch thicker, to pillar on.											
The remaining part of the deck is laid with English oak, or the best East-country plank, fastened with two $\frac{3}{4}$-inch short											I
with Prussian deal not more than ten inches broad, clear of sap, and fastened with nails in the beams and ledges.											
SPIRKETTING.—Number of strakes on each side............	*2 or 3*	*2 or 3*	*2 or 3*	*2 or 3*	*2 or 3*	*2 or 3*	*two*	*two*	*two*	*two*	K
From the waterways to the upperside of the sills, or....................................*in breadth*	...	...	...	...	...	...	2 2	2 2	2 0	2 0	L
Thickness { *Lower edge*............................	0 7	0 7	0 7	0 7	0 $6\frac{1}{2}$	0 6	0 $5\frac{1}{2}$	0 5	0 5	0 5	M
Thickness { *Upper edge*............................	0 6	0 6	0 6	0 6	0 $5\frac{1}{2}$	0 5	0 5	0 $4\frac{1}{2}$	0 $4\frac{1}{2}$	0 4	N
To have a bolt clenched inside, through every butt in the next timber..................*diameter...*	0 $1\frac{1}{8}$	0 $1\frac{1}{8}$	0 1	0 1	0 1	0 $0\frac{7}{8}$	0 $0\frac{7}{8}$	0 $0\frac{7}{8}$	0 $0\frac{7}{8}$	0 $0\frac{7}{8}$	O
STUFF—Between the ports in..................*thickness...*	0 4	0 4	0 4	0 4	0 $3\frac{1}{2}$	0 3	0 3	0 3	0 3	0 3	P
Upon the spirketting and under the clamps, *thickness...*	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	Q
HAWSE HOOK.—Under the holes or hooks between decks *sided...*	1 3	1 $2\frac{1}{2}$	1 2	1 2	1 1	1 $0\frac{1}{2}$	1 0	0 $11\frac{1}{2}$	0 $11\frac{1}{2}$	0 11	R
Placed half the siding below the holes, and in *length*	20 0	19 6	19 3	19 0	18 6	18 0	17 6	17 0	17 0	16 6	S
Fayed upon the stuff, and } ....*number...*	15	15	13	13	13	13	11	11	11	11	T
bolted with bolts in..... } ....*diameter..*	0 $1\frac{3}{8}$	0 $1\frac{3}{8}$	0 $1\frac{3}{8}$	0 $1\frac{3}{8}$	0 $1\frac{3}{8}$	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$	V
Iron hawse-hook under the holes to weigh.......	...	...	...	...	...	...	...	...	...	...	W
BREADTH RIDERS.—Number on each side..................	13	13	12	12	12	11					
sided......	1 2	1 2	1 $1\frac{1}{2}$	1 1	1 $0\frac{1}{2}$	1 0					
moulded...	1 1	1 0	1 0	1 0	1 0	0 11					
Length, from the underside of the upper-deck beams, or middle deck beams in three-decked ships, to six inches of the upper-											X
driven through the beams they face on.											
Bolted with bolts, in *number*	11	11	11	11	11	9					
diameter......................	0 $1\frac{3}{8}$	0 $1\frac{3}{8}$	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$	0 $0\frac{1}{4}$	0 $1\frac{1}{4}$					
CARLING { Under the fire-hearth ....*square*	1 2	1 1	1 0	1 0	0 11	0 11	0 10	0 9	0 9	0 9	Y
CARLING { Let up and face on between the beams........	0 2	0 2	0 2	0 2	0 2	0 2	0 $1\frac{1}{2}$	0 $1\frac{1}{2}$	0 $1\frac{1}{2}$	0 $1\frac{1}{2}$	Z
CARLING { In length from the aftside of the foremost beam of the fore-hatchway to the foreside of the beam next abaft the foremast. Bolted up in the middle with three bolts $\frac{7}{8}$ to $\frac{3}{4}$ inch diameter. To have fir fillings upon the carling to the underside of the ledges.											
PILLARS.—One under each beam between decks to be neatly turned and square { *upper end...*	0 9	0 9	0 8	0 8	0 7	0 7	0 7	0 7	0 7	0 6	A
{ *lower end...*	0 10	0 10	0 9	0 9	0 8	0 8	0 8	0 8	0 8	0 7	B
STANDARDS or RIDERS.—On each side, in *number*	*twelve*	*twelve*	*twelve*	*twelve*	*ten*	*ten*	*eight*	*eight*	*eight*	*eight*	C
If wood to be well grown and *sided*...............	1 1	1 $0\frac{1}{2}$	1 0	1 0	1 0	0 $11\frac{1}{2}$	0 11	0 10	0 10	0 $9\frac{1}{2}$	D
If iron (in the officers cabins) in *weight* each.....	4 2 0	4 1 0	4 0 0	4 0 0	3 3 0	3 2 0	3 1 0	3 0 0	2 3 0	2 2 0	E
Thwartship arms..............*long*	4 10	4 9	4 8	4 7	4 6	4 4	4 0	3 9	3 7	3 5	F
Bolts..........................*in number*	*nine*	*nine*	*nine*	*nine*	*nine*	*nine*	*nine*	*eight*	*eight*	*eight*	G
diameter	0 $1\frac{3}{8}$	0 $1\frac{3}{8}$	0 $1\frac{3}{8}$	0 $1\frac{3}{8}$	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$	0 $1\frac{1}{8}$	H
PORT LIDS.—Every gun-deck port to be fitted with a substantial lid made of English oak—Stops of the ports not less than	0 $3\frac{1}{2}$	0 $3\frac{1}{2}$	0 $3\frac{1}{2}$	0 $3\frac{1}{2}$	0 3	0 3					

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigan-tine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	0 3½	0 3½	0 3	...	...	...	0 3	0 3	0 4	0 4	0 4	0 4	0 4	0 3	...	...	0 3	
B	the thickness of the spirketting bearded back about half an inch. The butts of the waterways that come between riders tail in about																	
C	fayed close up under the waterway and against the rider, and nailed thereto. Merchant ships have iron plates let into the openings																	
D	0 2½	0 2½	0 2	...	...	...	0 2	0 2	0 3	0 3	0 3	0 3	0 2½	0 2	...	...	0 2	
E	*three*	*three*	*two*	...	...	...	*one*	*one*	*three*	*three*	*three*	*two*	*two*	*one*	...	...	*one*	
F	...	...	...	...	...	...	...	...	0 4	0 4	0 4	0 4	0 3½	0 3	...	...	0 2½	
G	aft with the butts so disposed as to give the greatest shift to the hatchways, ladderways, mast partners, and to each other. To be																	
H	the headledges in midships, with oak one inch thicker than the deck-flat, and rounded to that size at the coamings.—The midship																	
I	bolts in each beam, and one tree-nail in each ledge, in ships having gun-decks. But frigates, and under, have the lower deck laid																	
K	*two*	*two*	*two*	...	...	...	*one*	*one*	*two*	*two*	*two*	*two*	1 *or* 2	1 *or* 2	...	...	1 *or* 2	
L	1 10	1 10	1 9	...	...	...	0 11	0 10½	1 10	1 10	1 10	1 8	1 8	1 6	...	...	1 6	
M	0 4½	0 4	0 3	...	...	...	0 3	0 3	0 4	0 4	0 4	0 4	0 3½	0 3	...	...	0 3	
N	0 4	0 3½	0 3	...	...	...	0 2½	0 2½	0 4	0 4	0 4	0 4	0 3½	0 3	...	...	0 3	
O	0 0¾	0 0¾	0 0¾	...	...	...	0 0¾	0 0¾	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	...	...	0 0¾	
P	0 2½	0 2½	0 2	...	...	...	0 1½	0 1½	0 4	0 4	0 4	0 3	0 3	0 2½	...	...	0 2	
Q	0 2½	0 2½	0 2	...	...	...	0 1½	0 1½	0 4	0 4	0 4	0 3	0 3	0 2½	...	...	0 2	
R	0 10½	0 10	0 9															
S	16 0	15 0	13 0	...	...	...	...	...	16 0	16 0	15 6	15 0	14 0	13 0				
T	*nine*	*nine*	*nine*	...	...	...	...	...	10	10	10	10	*eight*	*eight*				
V	0 1⅛	0 1⅛	0 1⅛	...	...	...	...	...	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1⅛				
W	...	...	...	...	...	...	...	*cwt.*	7 0 0	7 0 0	6 3 0	6 2 0	6 1 0	5 0 0				
X	side of the Orlop beams. The said riders to stand as diagonally as the beams, &c. will admit, and to have two fore and aft bolts																	
Y	0 9	0 8	0 8															
Z	0 1½	0 1	0 1															
A	0 6	0 6	0 5½	Tenoned at the head into the beam and chased fore and aft at the heel.				...	0 7	0 7	0 7	0 6	0 6	0 5½	...	...	0 5	
B	0 7	0 7	0 6½					...	0 8	0 8	0 8	0 7	0 7	0 6½	...	...	0 6	
C	*six*	*six*	*four*	...	...	...	...	...	...	...	...	...	...	...	...	...	*three*	
D	0 9	0 8½	0 8	Wood or iron standards in the navy are to fay upon shoals of English plank 4 to 3 inches thick.													0 8	
E	2 1 0	2 0 0	1 3 0	...	...	...	...	...	3 0 0	2 3 0	2 2 0	2 0 0	1 3 0	1 2 0				
F	3 2	3 0	2 10	Side arm to reach the beam above.					4 4	4 4	4 2	4 0	3 9	3 6	...	...	3 2	
G	*eight*	*eight*	*seven*	...	...	...	...	...	*seven*	*seven*	*seven*	*seven*	*seven*	*seven*	..	...	*six*	
H	0 1⅛	0 1⅛	0 1	...	...	...	...	...	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	...	...	0 1	

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
Gun or Lower Deck—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Well-seasoned linings fitted into the stops, *thick*	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1					
To have a scuttle through the lid of each port hung with horseshoe hinges from forward { *long*	0 9	0 9	0 9	0 9	0 9	0 9	...	...	...	...	A
{ *deep*	0 6	0 6	0 6	0 6	0 5	0 5	...	...	...	...	B
Each port to be hung with two hinges of iron, *broad*	0 4¼	0 4¼	0 4	0 4	0 3¾	0 3¾	...	...	...	...	C
thick at the shoulder	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 1	...	...	...	...	D
(The points well clenched.) Hooks, *diameter....*	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	...	...	...	...	E
Saucer-headed bolts, and shackle bolts, *diameter*	0 1	0 1	0 1	0 1	0 1	0 0⅞	...	...	...	...	F
Shackle rings.....................*in the clear......*	0 3½	0 3½	0 3	0 3	0 3	0 2¾	...	...	...	...	G
To have lead pipes through the side, one over each hinge..............*in diameter...........*	0 1½	0 1½	0 1⅜	0 1⅜	0 1⅜	0 1¼	...	...	...	...	H
To have iron hooks for the port tackles driven in the side of the beam most opposite { *first hook...*	9 0	8 0	7 6	7 6	7 0	6 9	...	...	...	...	I
{ *second hook*	11 0	10 0	9 6	9 6	9 0	8 9	...	...	...	...	K
The iron cleat to be kept from the side	13 0	12 0	11 6	11 6	11 0	10 9	...	...	...	...	L
Manger.—The manger stantions.................*broad...*	1 6	1 6	1 5	1 5	1 4	1 3	0 9	0 9	0 9	0 8	M
thick...	0 7	0 7	0 6	0 6	0 5	0 5	*square*				
Manger boards to stand square with the bow, and *thick...*	0 4	0 4	0 4	0 4	0 4	0 4	0 3½	0 3½	0 3½	0 3½	N
And fitted into rabbets, to ship and unship, and when made of two pieces to be rabbetted together: the breadth or depth											O
side of the holes, fay close down upon the deck, and well canted on the aftside.—See Hawse Pieces for diameters, &c.											
Blind and Riding Bucklers * to be elm plank, *thick...*	0 4	0 4	0 4	0 4	0 4	0 4	0 3½	0 3½	0 3½	0 3	P
Buckler-bars, oak, *square...*	0 4	0 4	0 4	0 4	0 4	0 4	0 3½	0 3½	0 3½	0 3	Q
Scuppers.—To be of lead on each side, *in the manger...*	*two*	*two*	*two*	*two*	*two*	*two*	*one*	*one*	*one*	*one*	R
diameter in the clear...	0 6	0 6	0 5	0 5	0 5	0 5	0 5	0 5	0 5	0 5	S
To have on each side lead scuppers, *in number...*	*eight*	*eight*	*six*	*six*	*six*	*six*	*three*	*three*	*three*	*three*	T
Pumpdale scuppers, one on each side, *diameter in the clear...*	0 7	0 7	0 7	0 7	0 6	0 6	...	...	...	...	U
							Pipes in the rooms.				
Diameter of the scuppers along the sides........	0 5	0 5	0 4	0 4	0 4	0 4	0 3	0 3	0 3	0 3	X
Scuppers are let out from the inside, with broad flaps, let in flush, and kept well down with the deck. A coat of tar and											Y
sometimes turned upon the outside stuff, and sometimes let in flush, and nailed with copper-nails. In spacing the scup-											Z
bolts of hanging knees; manger scupper clear of the cheeks, and let out one above the other. Care must also be											A
Iron-work.—Two muzzle lashing eye bolts, *diameter...*	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	...	...	...	...	B
the eyes in the clear.........	0 3	0 3	0 2¾	0 2¾	0 2¾	0 2⅝	...	...	...	...	C
To have four ring and two eye-bolts, to each port.............................*diameter.........*	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1¼	...	...	...	...	D
rings in the clear	0 6	0 6	0 5	0 5	0 5	0 4¾	...	...	...	...	E
eyes in the clear	0 2¼	0 2¼	0 2	0 2	0 2	0 1¾	...	...	...	...	F
Eye-bolts one between every port, *diameter.....*	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1¼	0 1¼	...	...	...	...	G
eyes in the clear..........	0 2½	0 2½	0 2¼	0 2¼	0 2¼	0 2	...	...	...	...	H
Ring-bolts one opposite each port in the deck, *diameter...................*	0 1⅛	0 1⅛	0 1¼	0 1⅛	0 1⅛	0 1⅛	...	...	...	...	I
rings in the clear.........	0 4	0 4	0 3¾	0 3¾	0 3½	0 3½	...	...	...	...	K
Stopper-bolts or ring-bolts for the stoppers......... { *diameter ....*	0 1¾	0 1¾	0 1⅝	0 1⅝	0 1⅝	0 1⅝	..	...	...	...	L
{ *rings in the clear...*	0 8	0 8	0 7	0 7	0 6½	0 6¼	...	...	...	...	M
Tiller.—To be clear of knots, and square at the fore part of the hole..................................	1 1	1 0	0 11	0 11	0 10¾	0 10¾	0 10¾	0 10¾	0 10¾	0 10½	N
To continue of that bigness before the rudder-head..	2 6	2 6	2 3	2 3	2 0	2 0	2 0	2 0	2 0	2 0	O
Foremost end square..............................	0 10	0 9	0 8	0 7	0 7	0 7	0 7	0 6½	0 6½	0 6	P
In length, or to pass freely by the mizen-mast,..	29 6	28 0	27 0	26 0	24 6	24 0	23 0	22 0	21 0	20 0	Q
Eye-bolts driven in the tiller, and fore part of rudder..........................*diameter........*	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	R

* The bucklers to fay close over each hole between the hawse hook and deck hook over the holes, and each buckler separated by oak cants, fayed and nailed to the side, one cant in the middle, between the holes, and one at each end, to come out flush with the bucklers. Each buckler is to be barred in with two bars, chaced about into the hooks. The blind buck.ers to be in one piece, and each riding buckler in two pieces, rabbetted together in the middle, with a hole cut half way in each piece, to admit the cable. Ships that have no hawse hook, have a bolster about 4 inches

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
A B	In the clear, the undersides two-thirds of the depth of the port up from the sill.																	
C D	The hooks to be driven high enough up above the stop of the port, that the underside of the lid may be clear of the underside of the upper sills, when the lids are opened level. The foremost and after lids to be hung with the sheer of the ship when opened.																	
E F G	Each hinge to be fastened to the lid with the saucer bolt at the shoulder, clenched outside upon a thin ring. The inner shackle for barring in the ports to be driven in; the ring to stand upright one inch clear of lower sill, and clenched outside upon a thin ring. The outer shackles are driven close below the inner shackles; the rings to lie level for hauling up the ports, and clenched upon a small ring inside.																	
H	In the clear for the port ropes, the holes to be bored as high up as possible, on the inside, and stive well up outwards.																	
I K L	From the ship's side, and both hooks and cleats to be kept as high up as possible, giving room for the turns of the fall.																	
M	0 8	0 7	0 7															
N	0 3	0 3	0 3															
O	of the manger boards to be equally high with the middle of the hawse holes, and hanced down towards the middle to the under-																	
P	0 3	0 3	0 2½	Plugs	0 2½		Plugs.		0 4	0 4	0 4	0 3	0 3	0 3	0 2½			
Q	0 3	0 3	0 3		0 3				0 4	0 4	0 4	0 3	0 3	0 3	0 3			
R	one	one	one	one	one	one	one	one										
S	0 5	0 5	0 5	0 5	0 5	0 5	0 5	0 5										
T	three	three	three	Lead pipes.														
U	To have broad flaps on the inside, and the said flaps let into the spirketting to receive the end of the pumpdale.																	
X	0 3	0 3	0 3															
Y	hair is put behind the flaps, and every care should be taken to keep the said flap tight and secured from leakage. The outsides are																	
Z	pers, the utmost attention is required to clear them of the ports and scuttles, chain plates, steps on the side, anchor linings, and throat																	
A	taken that no port-timbers are wounded by letting out the scuppers.																	
B C	To be placed as high as possible, about 12 inches asunder, equally from the middle of the port. The eyes to stand fair with the turns of lashing. Note, Ring and eye-bolts to be driven with a socket punch, the eyes only clear of the wood, and the rings sufficiently to turn.																	
D E F	One ring and one eye-bolt to be driven in each port timber; the eye-bolt placed at half the depth of the port, and on the timber, from the side of the port, one-third of the siding. The ring-bolt to be placed half way between the eye-bolt and lower sill, two-thirds of the siding of the port timber from the edge, and one ring-bolt in the same range on the second timber from the port on each side.																	
G H	The ring-bolts to be so driven that the rings may hang upright, or perpendicular, and the eyes of the eye-bolts the same, unless the eye-bolts between the ports have their eyes to stand level; and all the bolts to be well clenched upon the outside stuff.																	
I K	To be driven without the coamings abreast of each port, unless there are any in the deck to answer the purpose.																	
L M	To have short snug eyes let well in the deck, to be driven in the binding strakes on each side, in the range of the outside of the riding bitts, driven towards the aftside of each beam from the main hatch and riding bitts, and well clenched upon iron plates let up flush in the beams.																	
N	0 10¼	0 10	0 9	0 6¼	0 7	0 6½	0 6¾	0 6¾	0 11	0 10	0 9½	0 9¼	0 9	0 8	0 7	0 6	0 6½	0 5½
O	1 9	1 6	1 6	1 3	1 6	1 3	1 3	1 3	2 0	2 0	2 0	1 9	1 6	1 3	1 2	1 0	1 0	0 10
P	0 6	0 6	0 5	0 4½	0 5	0 4	0 4	0 4	0 7	0 7	0 7	0 6	0 6	0 5	0 4	0 4	0 4½	0 3½
Q	19 0	18 0	14 0	10 9	12 0	12 0	13 0	12 0	24 0	23 0	22 0	18 6	16 0	14 0	12 0	10 6	12 0	8 6
R	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0⅞	0 0¾	0 0¾	0 0¾										

thick, fayed and bolted under the holes, of sufficient length and breadth to provide for the buckler-bars, &c.—Hawse plugs are made of fir to fit the holes, and a ring bolt, ¾ of an inch diameter, is driven in the inner end: two are hollowed, or grooved, along the sides, to drive over the cables when riding. Each plug is about 2 feet 6 inches long.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
GUN or LOWER DECK—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Iron rod, screw cut at fore end, and eye in after end.....................................*diameter*	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	A
Saucer-head bolts for the goose-neck plates...... *diameter*...	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	B

Tillers in the Royal Navy are fitted with an eye-bolt driven in each side about two feet before the rudder, or have an iron C
On the fore end of the tiller, close afore the sweep, is driven a hoop, called a horn hoop, with an eye standing up on each side, D
fore end of the tiller. Then an eye-bolt is driven on each side about two thirds of the length of the tiller from the fore-end.

GOOSENECK, made of iron, about three inches broad, and 14 inches long, the bottom to project beyond the sides about half an inch, E
screw cut at the point; the underside of the neck to have a brass or bell-metal sole rivetted thereto. The Goose-neck is F
Gooseneck may shift forwards as the tiller works aft. The plates are fastened by two bolts in each, drove from G

	110	98	80	74	64	50	44	38	36	32	
To have one spare tiller fitted as the former, and another tiller fitted in the upper hole.											
India ships have their tillers plated with iron and hooped.—The plates...............*long*...	...	...	...	...	...	...	...	...	...	...	H
broad..	...	...	...	...	...	...	...	...	...	...	I
TILLER SWEEP—Made of oak plank to sweep equal to the radius made by the tiller.................................. *thick*...	0 3	In all King's ships the tiller sweep is thus fitted alike. The pieces									K
		thickness down, and 2¼ inches on this rabbet shod with an iron									L
broad...	0 11	made flush. To have a rabbet taken out on the foreside, two									M

beyond the rabbet, ten to twelve in number, equally distant. The upper side of the sweep is lined with 1¼ inch oak board N
and in breadth to cover the upperside, and project to the foreside, to which a ⅝ oak batten is screwed, to keep the rope in, O
of the sweep is fitted a block, with an horizontal sheave to lead the tiller ropes forward, under the wheel, where a block is P
and the blocks bolted up in the same manner as the sweep.

CABINS for the OFFICERS.—In frigates and small vessels—To build on each sides six cabins abaft the main-mast, each cabin six feet Q
and a sash with stone ground glass. The sash and door placed clear of the beams, that they may half-pillar into the side, R
and with lockers and a cupboard. To line the side in way of the cabins, and to have a bread bin on each side abaft the S
mess room.

SCUTTLES for Air and Light.—Each cabin to have a scuttle, nine inches fore and aft, and seven inches deep in the clear, with four T
scuttles to be cut ¾ of an inch below a level from the inside to the inner part of the outside stuff, the sides of the scuttles to U
The lids to be hung on the outside, from forward, with horseshoe hinges.

	110	98	80	74	64	50	44	38	36	32	
SHOT RACKS—To be of oak.........................*broad*...	0 8	0 8	0 8	0 8	0 7	0 7	To be bolted to the outsides				X
deep....	0 6	0 6	0 6	0 6	0 5	0 5	from the side of the coamings				Y
Bolted to the coaming..............*bolt's diameter*	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	keeping the shot two inches				Z
							inch below the uppersides				A
PUMPS—To be fitted with pumps......... ....*in number*..........	*four*	*four*	*four*	*four*	*four*	*two*	*two*	*two*	*two*	*two*	B
............*size, if copper*......	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	C
............*size, if chain*......	0 7	0 7	0 7	0 7	0 7	0 7	0 7	0 7	0 7	0 7	D
And two wood pumps with brass chambers, size	0 7	0 7	0 7	0 7	0 7	0 7	0 7	0 7	0 7	0 7	E
Pump Cisterns on each side the main mast......	*two*	*two*	*two*	*two*	*two*	*one*	...	Oak plank for the bot-			F
deep......................	3 3	2 9	2 8	2 7	2 7	2 6	...	three inches thick,			G
broad from out to outside	2 6	2 0	2 0	2 0	2 0	2 0	...				
Ends without the heads of the pumps...........	1 0	1 0	0 10	0 9	0 8	0 8	...	To have two parti-			H
Centres of the rhodings above the deck.........								cistern pump on			I
In East India ships, the four pumps work with a windlass and brakes, viz...................... Windlass, in *length*	...	...	...	...	...	...	...	...	...	...	K
square	...	...	...	...	...	...	...	...	...	...	L
Brakes or Cross-bars *length*	...	...	...	...	...	...	...	...	...	...	M
square	...	...	...	...	...	...	...	...	...	...	N
Windlass Stantions...........................*thick*	...	...	...	...	...	...	...	...	...	...	O
...*broad*	...	...	...	...	...	...	...	...	...	...	P
The handles are made to ship or unship in the brakes of the windlass with a stirrup and iron-pin fore-locked on the underside. In length *about*...	...	...	...	...	...	...	...	...	...	...	Q
brakes.... *square*..	...	...	...	...	...	...	...	...	...	...	R
handles...*diameter*	...	...	...	...	...	...	...	...	...	...	S
in length	...	...	...	...	...	...	...	...	...	...	T

HAMMOCK RACKS, made of oak batten, two inches square, and trimmed with a hole at the distance of every 16 inches, hollowed out to U
battens to be rounded, and well nailed to the beams, &c. nine feet apart, each batten beginning forward and then a mid- X
TRICING BATTENS to be two inches thick, and four inches broad, with the edges rounded, to be nailed up between the athwartships Y

* For an improved Plan for battening and birthing the Hammocks, the reader is referred

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigan-tine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
—	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	0 0$\frac{7}{8}$	0 0$\frac{7}{8}$	0 0$\frac{7}{8}$	0 0$\frac{3}{4}$	0 0$\frac{7}{8}$	Iron plate over the eye-bolt and toggles.												
B	0 0$\frac{3}{4}$	0 0$\frac{3}{4}$	0 0$\frac{3}{4}$	0 0$\frac{3}{4}$	0 0$\frac{3}{4}$													
C	hoop with eyes driven on, through which the rod screws with a nut to keep the tiller aft as it shrinks.																	
D	to convey the rope into the foreside of the sweep ; and another hoop, with an eye on each side is let on flush, its breadth close to the																	
E	and the same thickness up from the lower side, to have two holes along the middle to admit of two eye-bolts $\frac{5}{8}$ of an inch diameter,																	
F	attached to the upperside of the tiller by a plate of iron, on each side of it, about 2$\frac{1}{2}$ inches broad, and half an inch thick, that the																	
G	underside and forelocked upon the plate.																	
H	...	...	...	...	...	...	...	...	12 0	12 0	10 0	and barely $\frac{1}{8}$ of an inch thick.						
I	...	...	...	...	...	...	...	...	0 4	0 4	0 3$\frac{3}{4}$							
K	of plank composing the sweep are put together with a flat scarph, about 18 inches long; on the aft side a rabbet is taken out half the																	
L	plate for the gooseneck to traverse on. The plate is about three eighths of an inch thick, screwed down, and the heads of the screws																	
M	inches down, and three inches on, in this rabbet are fitted lignum vitæ rollers, about three inches in diameter, let in half the diameter																	
N	to receive the brass pins which the rollers work on. The oak board, which is 1$\frac{1}{4}$ thick, to give scarph to the scarphs of the plank,																	
O	and the aftside hollowed. The sweep is bolted up to the undersides of the beams, with 1$\frac{1}{8}$ inch bolts, saucer headed. To each end																	
P	fitted with a vertical sheave, on each side the middle line, in the direction of the rope. The sheaves are eight inches by 1$\frac{1}{4}$ thick,																	
Q	long, and five feet wide, or more; with panels put up in grooves at the front. Each cabin to have a swing door, 22 inches wide,																	
R	or with an oak stantion, about five inches thick, and eight broad. The insides to be fitted with bed places, two feet six inches broad,																	
S	cabin's and athwartship bulkhead, built upon a cant abaft the second cabin from forward, with a door on each side to part off the																	
T	scuttles from the cabins forward, cut through the side to stive upwards about four inches in the depth of the side. The bottom of the																	
U	be lined with lead, the lower corners soldered, and a hole made to lead the water down the sides, or a pipe to lead it to the outside.																	
X	of the coamings and head ledges; the bolts about 16 inches asunder, and clenched on the outsides of the racks. To be kept out																	
Y	an inch more than the size of the shot, and the upper sides gouged and hollowed to the size of the shot at one-third of its diameter,																	
Z	asunder in the clear. To have pieces in the wake of the bolts, and the uppersides of the racks so placed, that the shot may be one																	
A	of the coamings. The racks need no corner pieces when bolted sufficiently.																	
B	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	2 *of*	2 *of*	2 *of*	2 *of*	2 *of*	2 *of*	2 *of*	2 *of*	2 *of*	1 *of*
C	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	1 0	0 7	0 7	0 7	0 5	0 5	0 5	0 5
D	0 7	0 7	0 7	...	...	...	...	...	2 *of*	2 *of*	2 *of*	2 *of*	2 *of*					
E	0 7	0 7	0 7	...	...	...	...	...	0 7	0 7	0 7	0 7	0 7					
F	toms four inches thick, the ends five inches, and the sides								0 4	0 4	0 4	Ends sides and bottom four inches thick.						
G	rabbetted neatly together and caulked.								2 7	2 7	2 7							
									6 0	6 0	6 0							
H	tions in the middle, three inches thick, and inch asunder, so that as a saw may separate them. In the Royal Navy, ships have a																	
I	the starboard side, for the convenience of washing decks, &c.																	
K	...	...	...	...	...	...	...	...	6 0	6 0	6 0							
L	...	...	...	...	...	...	...	...	0 10	0 10	0 9							
M	...	...	...	...	...	...	...	...	5 0	5 0	5 0							
N	...	...	...	...	...	...	...	...	0 4$\frac{1}{2}$	0 4$\frac{1}{2}$	0 4$\frac{1}{2}$							
O	...	...	...	...	...	...	...	...	0 4$\frac{1}{2}$	0 4$\frac{1}{2}$	0 4$\frac{1}{2}$							
P	...	...	...	...	...	...	...	...	0 9	0 9	0 9							
Q	...	...	...	...	...	...	...	...	7 0	7 0	7 0							
R	...	...	...	...	...	...	...	...	0 4	0 4	0 4							
S	...	...	...	...	...	...	...	...	0 2$\frac{1}{2}$	0 2$\frac{1}{2}$	0 2$\frac{1}{2}$							
T	...	...	...	...	...	...	...	...	7 0	7 0	7 0							
U	reeve the laniard through, or otherwise kept off the beams with elm buttons behind them half an inch thick ; the outsides of the																	
X	dle tier between them.																	
Y	to trice up the hammocks*.																	

to Ross's "*Perpetual Birthing and Watch Bill Book*," published by P. Steel, London.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	Guns 110	Guns 98	Guns 80	Guns 74	Guns 64	Guns 50	Guns 44	Guns 38	Guns 36	Guns 32	
MIDDLE DECK.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Middle Deck Clamps.—Strakes, *in number*	*two*	*two*	...	...	...	...	...	...	...	...	A
Thick at the upper edge	0 7½	0 7	...	...	...	...	...	...	...	...	B
lower edge	0 6½	0 6	...	...	...	...	...	...	...	...	C
Scarphs, *in length*	3 9	3 6									
Bolted with two bolts in each, *diameter*	0 0⅞	0 0⅞									
Upper strake, *broad*	...	...	...	...	...	...	...	...	...	...	D
Lower strake, *broad*	...	...	...	...	...	...	...	...	...	...	E
Middle Deck Hook *sided*	1 3	1 2½	...	...	...	...	...	...	...	...	F
length	18 6	18 0	...	...	...	...	...	...	...	...	G
Bolted with bolts, *in number*	13	13	...	...	...	...	...	...	...	...	H
diameter	0 1⅜	0 1⅜	...	...	...	...	...	...	...	...	I
Breast-hook under the bowsprit for the cook room deck { *sided*	...	...	...	...	...	...	...	...	...	...	K
{ *length*	...	...	...	...	...	...	...	...	...	...	L
Bolted with bolts, *in number*	...	...	...	...	...	...	...	...	...	...	M
diameter	...	...	...	...	...	...	...	...	...	...	N
Beams.—Beams to round up	0 7	0 7	...	...	...	...	...	...	...	...	O
Plank of the deck, *thick*	0 3	0 3	...	...	...	...	...	...	...	...	P
Height from the upperside of the plank to the upperside of the upper deck beam at the middle line { *afore*	7 1	7 0	...	...	...	...	...	...	...	...	Q
{ *midships*	7 1	7 0	...	...	...	...	...	...	...	...	R
{ *abaft*	7 1	7 0	...	...	...	...	...	...	...	...	S
Height from the plank to the port-sills	2 2	2 2	...	...	...	...	...	...	...	...	T
Ports *Deep*	2 9	2 8	...	...	...	...	...	...	...	...	U
Fore and aft	3 3	3 4	...	...	...	...	...	...	...	...	X
Distant from each other	7 10	7 9	...	...	...	...	...	...	...	...	Y
In number	34	32	...	...	...	...	...	...	...	...	Z
Foreside of the foremost port, abaft the foremost perpendicular	7 0	5 6	...	...	...	...	...	...	...	...	A
Aftside of the after port, afore the after perpendicular	6 9	11 2	...	...	...	...	...	...	...	...	B
Sills Lower sills, *deep*	0 7	0 7	...	...	...	...	...	...	...	...	C
Upper sills, *deep*	0 6	0 6	...	...	...	...	...	...	...	...	D
Upper sills in wake of fore and main channels, *deep*	1 0	1 0	...	...	...	...	...	...	...	...	E
Beams *sided*	1 3½	1 2½	...	...	...	...	...	...	...	...	F
moulded	1 1½	1 1	...	...	...	...	...	...	...	...	G
number	31	30	...	...	...	...	...	...	...	...	H
Bolts in the scarphs, *number*	*eight*	*eight*	...	...	...	...	...	...	...	...	I
Square iron *diameter*	0 1⅛	0 1⅛	...	...	...	...	...	...	...	...	K
Ends of the beams to let down upon clamps	0 2¼	0 2	...	...	...	...	...	...	...	...	L
Transom *deep*	0 11½	0 11	...	...	...	...	...	...	...	...	M
moulded at the middle	1 5	1 4	...	...	...	...	...	...	...	...	N
at the ends	0 11	0 10	...	...	...	...	...	...	...	...	O
Scored aft, and bolted to the counter-timbers, *bolt's diameter*	0 1⅛	0 1⅛	...	...	...	...	...	...	...	..	P
Knee'd at each end with a cast, *sided*	10 0	9 0	...	...	...	...	...	...	...	...	Q
Knee under the two after beams, and thwartship arm *long*	5 0	4 9	...	...	...	...	...	...	...	...	R
Bolts in number, in the fore and aft arm	*six*	*six*	...	...	...	...	...	...	...	...	S
In the thwartship arm	*four*	*four*	...	...	...	...	...	...	...	...	T
Bolts *diameter*	0 1¼	0 1¼	...	...	...	...	...	...	...	...	U
If iron knees, to weigh *cwts.*	...	...	...	...	...	...	...	...	...	...	X
Knees.—The beams to be knee'd at each end with 1 hanging and 1 lodging knee { Hanging knees, *sided*	0 10	0 9½	...	...	...	...	...	...	...	...	Y
{ Hanging arm, *long*	5 9	5 9	...	...	...	...	...	...	...	...	Z
{ Thwartship arm, *long*	4 3	4 0	...	...	...	...	...	...	...	...	A
Number of bolts in the hanging arm	*five*	*five*	...	...	...	...	...	...	...	...	B
thwartship arm	*four*	*four*	...	...	...	...	...	...	...	...	C
diameter of bolts	0 1¼	0 1¼	...	...	...	...	...	...	...	...	D
Iron knees abaft and close forward to weigh	3 0 0	2 3 0	...	...	...	...	...	...	...	...	E
Lodging knees *sided*	0 10	0 9	...	...	...	...	...	...	...	...	F
Thwartship arm *long*	4 10	4 6	...	...	...	...	...	...	...	...	G

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544.	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
A	...	...	...	...	...	...	...	...	*two*	*two*	*two*	...	*two*					
B	...	...	...	...	...	...	...	...	0 5	0 5	0 5	...	0 4					
C	...	...	...	...	...	...	...	...	0 5	0 5	0 5	...	0 4					
D	...	...	...	...	...	...	...	...	1 1	1 1	1 0	...	0 11					
E	...	...	...	...	...	...	...	...	1 0	1 0	0 11	...	0 11					
F	...	...	...	...	...	...	...	...	1 2	1 2	1 1½	...	0 11					
G	...	...	...	...	...	...	...	...	18 0	18 0	17 0	...	15 0					
H	...	...	...	...	...	...	...	...	13	13	12	...	11					
I	...	...	...	...	...	...	...	...	0 1⅜	0 1⅜	0 1¼	...	0 1⅛					
K	...	...	...	...	...	...	...	...	1 1½	1 1	1 0½	...	0 11					
L	...	...	...	...	...	...	...	...	17 0	17 0	16 0	15 0	14 6					
M	...	...	...	...	...	...	..	...	*eleven*	*eleven*	*eleven*	*ten*	*ten*					
N	...	...	...	...	...	...	...	...	0 1⅜	0 1⅜	0 1¼	0 1⅛	0 1⅛					
O	...	...	...	...	...	...	...	...	0 7	0 7	0 6	...	0 5					
P	...	...	...	...	...	...	...	...	0 3	0 3	0 3	...	0 3					
Q	...	...	...	...	...	...	...	...	6 6	6 4	6 4	...	6 0					
R	...	...	...	...	...	...	...	...	6 6	6 4	6 4	...	6 0					
S	...	...	...	...	...	...	...	...	6 6	6 4	6 4	...	6 6					
T	...	...	...	...	...	...	...	...	2 0	2 0	2 0	...	2 1					
U	...	...	...	...	...	...	...	...	2 6	2 4	2 4	...	2 0					
X	...	...	...	...	...	...	...	...	2 10	2 9	2 7	...	2 6					
Y	...	...	...	...	...	...	...	...	7 8	7 8	7 8	...	7 5					
Z	...	...	...	...	...	...	...	...	28	28	26	...	22					
A	...	...	...	...	...	...	...	...	17 0	14 3	13 10	...	14 9					
B	...	...	...	...	...	...	...	...	9 2	8 10	7 9	...	5 5					
C	...	...	...	...	...	...	...	...	0 7	0 7	0 6	...	0 6					
D	...	...	...	...	...	...	...	...	0 6	0 6	0 5	...	0 5					
E	...	...	...	...	...	...	...	...	1 0	1 0	0 10	...	0 10					
F	...	...	...	...	...	...	...	...	1 1	1 1	1 0½	...	0 10					
G	...	...	...	...	...	...	...	...	0 11	0 11	0 10½	...	0 9					
H	...	...	...	...	...	...	...	...	27	27	25	...	19					
I	...	...	...	...	...	...	...	...	*seven*	*seven*	*six*	...	*six*					
K	...	...	...	...	...	...	...	...	0 1⅛	0 1	0 1	...	0 0⅞					
L	...	...	...	...	...	...	...	...	0 1½	0 1½	0 1½	...	0 1¼					
M	...	...	...	...	...	...	...	...	1 2	1 1	1 0½	...	0 10					
N	...	...	...	...	...	...	...	...	1 4	1 4	1 3	...	1 1					
O	...	...	...	...	...	...	...	...	0 11	0 11	0 10	...	0 9					
P	...	...	...	...	...	...	...	...	0 1⅛	0 1⅛	0 1	...	0 0⅞					
Q	...	...	...	...	...	...	...	...	8 0	8 0	7 6	...	5 6					
R	...	...	...	...	...	...	...	...	6 0	6 0	5 6	...	4 6					
S	...	...	...	...	...	...	...	...	*six*	*six*	*five*	...	*five*					
T	...	...	...	...	...	...	...	...	*five*	*five*	*four*	...	*three*					
U	...	...	...	...	...	...	...	...	0 1¼	0 1¼	0 1⅛	...	0 0⅞					
X	...	...	...	...	...	...	...	...	4 2 0	4 1 0	4 0 0	...	2 3 0					
Y	...	...	...	...	...	...	...	...	0 8	0 7½	0 7	...	0 6					
Z	...	...	...	...	...	...	...	...	4 6	4 6	4 0	...	4 0					
A	...	...	...	...	...	...	...	...	3 3	3 3	3 3	...	3 0					
B	...	...	...	...	...	...	...	...	*four*	*four*	*four*	...	*three*					
C	...	...	...	...	...	...	...	...	*three*	*three*	*three*	...	*three*					
D	...	...	...	...	...	...	...	...	0 1⅛	0 1⅛	0 1⅛	...	0 1					
E	...	...	...	...	...	...	...	...	2 2 0	2 1 0	1 3 14	...	1 1 14					
F	...	...	...	...	...	...	...	...	0 8	0 7½	0 7	...	0 6					
G	...	...	...	...	...	...	...	...	3 8	3 8	3 7	...	3 4					

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
Middle Deck—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Fore and aft arm the whole length between the beams, or length sufficient for bolts, *in number*	*four*	*four*	...	...	...	...	...	...	...	...	A
diameter...	0 1¼	0 1¼	...	...	...	...	...	...	...	...	B
Iron Lodging Knees (behind riders) to weigh *cwt.*	2 3 0	2 2 0	...	...	...	...	...	...	...	...	C
Hatchways to be over those on the Lower-deck, and of the same dimensions, viz. Fore, Main, & After.											
Ladderways and Companion thwartships........	5 2	5 0									
One next afore the Forehatch, fore and aft......	4 6	4 6									
Hatch—Aftside afore the centre of the foremast.........	...	...	...	...	...	...	...	...	...	...	D
Fore and aft...	...	...	...	...	...	...	...	...	...	...	E
Thwartships...	...	...	...	...	...	...	...	...	...	...	F
And one close abaft the Mizen-mast, fore and aft	...	...	...	...	...	...	...	...	...	...	G
Thwartships...	...	...	...	...	...	...	...	...	...	...	H
Ekeings to the Bows—To be of iron............*long*......	...	...	...	...	...	...	...	...	...	...	I
broad.....	...	...	...	...	...	...	...	...	...	...	K
To have one Ekeing between the middle deck and one above.............. } .... *thick*.....	...	...	...	...	...	...	...	...	...	...	L
.........Bolts in *number*...	...	...	...	...	...	...	...	...	...	...	M
.... *diameter.*	...	...	...	...	...	...	...	...	...	...	N
.... each to weigh	...	...	...	...	...	...	...	...	...	...	O
Partners of the Masts.—The Partners of the Main-mast *broad*....	1 8	1 7	...	...	...	...	...	...	...	...	P
deep.....	1 7	1 6	...	...	...	...	...	...	...	...	Q
Partners of the Fore-mast...............*broad*....	1 3	1 2	...	...	...	...	...	...	...	...	R
deep.....	1 4	1 3	...	...	...	...	...	...	...	...	S
Upper sides above the beam	0 7	0 6½	...	...	...	...	...	...	...	...	T
Two bolts in each end....................*diameter*	0 1	0 1	...	...	...	...	...	...	...	...	U
Mizen Partners.............. .... *thick*....	0 7	0 6½	...	...	...	...	...	...	...	...	X
broad ...	3 6	3 3	...	...	...	...	...	...	...	...	Y
Let down upon the beams	0 1½	0 1½	...	...	...	...	...	...	...	...	Z
Fastened with bolts......................*diameter*	0 1	0 1	...	...	...	...	...	...	...	...	A
Bowsprit Step or Partners.................*thick*....	...	...	...	...	...	...	...	...	...	...	B
broad....	...	...	...	...	...	...	...	...	...	...	C
Capstan Step—Fore Jear Step....................*broad*...	...	...	...	...	...	...	...	...	...	...	D
deep.....	...	...	...	...	...	...	...	...	...	...	E
Main Jear Step...................*broad* ..	...	...	...	...	...	...	...	...	...	...	F
deep.....	...	...	...	...	...	...	...	...	...	...	G
Two bolts in each end....................*diameter*	...	...	...	...	...	...	...	...	...	...	H
Plank wrought along the step............*thick*....	...	...	...	...	...	...	...	...	...	...	I
Main and fore...............................*thick*...	0 7	0 7									
Capstan Partners—Capstans..................... *broad*...	8 0	8 0									
Framed with Carlings.....................*broad*...	1 0	1 0									
deep....	1 1	1 1									
Carlings asunder in the clear......................	6 0	6 0									
Let down between the beams..........	0 1	0 1									
Framing bolted with bolts............*in diameter*	0 1	0 1									
Partners bolted two in each end......... *diameter*	0 1⅛	0 1⅛									
Iron hoop fitted in the partners..........*thick*...	0 0½	0 0½									
broad...	0 4	0 4									
RIDING BITTS.											
Dog Bitts... *square*...	...	...	...	...	...	...	...	...	...	...	K
Cross-piece............................. *square*...	...	...	...	...	...	...	...	...	...	...	L
To have upper Breadth Riders, the same as the Breadth Riders on the Gun-deck, to the Middle-deck beams. See Breadth Riders on the Gun-deck.											
Carlings—Number of tiers on each side from the Fore-hatch to the Mizen-mast room..................	*three*	*three*	...	...	...	...	...	...	...	...	M
Number of tiers thence forward and aft.........	*two*	*two*	...	...	...	...	...	...	...	...	N
Carlings in the hatchways, and at half beams one inch broader............ { *broad*...	0 10½	0 10	...	...	...	...	...	...	...	...	O
{ *deep*.....	0 8½	0 8	...	...	...	...	...	...	...	...	P

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. n.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft .in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	...	...	...	...	...	...	...	...	*four*	*four*	*four*	...	*three*					
B	...	...	...	...	...	...	...	...	0 $1\frac{1}{8}$	0 $1\frac{1}{8}$	0 $1\frac{1}{8}$	...	0 1					
C	...	...	...	...	...	...	...	...	1 3 10	1 2 14	1 2 0	...	1 1 0					
D	...	...	...	...	...	...	...	...	...	...	3 0							
E	...	...	...	...	...	...	...	...	...	...	4 0							
F	...	...	...	...	...	...	...	...	...	...	4 9							
G	...	...	...	...	...	...	...	...	...	...	2 3							
H	...	...	...	...	...	...	...	...	...	...	4 6							
I	...	...	...	...	...	...	...	...	16 0	16 0	15 0							
K	...	...	...	...	...	...	...	...	0 5	0 5	0 $4\frac{3}{4}$							
L	...	...	...	...	...	...	...	...	0 $4\frac{1}{2}$	0 $4\frac{1}{2}$	0 $4\frac{1}{4}$							
M	...	...	...	...	...	...	...	...	17	17	17							
N	...	...	...	...	...	...	...	...	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$							
O	...	...	...	...	...	...	...	...	6 0 0	6 0 0	5 3 0							
P	...	...	...	...	...	...	...	...	1 2	1 1	1 0	...	0 10					
Q	...	...	...	...	...	...	...	...	1 0	1 0	0 11	...	0 9					
R	...	...	...	...	...	...	...	...	1 2	1 1	1 0	...	0 10					
S	...	...	...	...	...	...	...	...	1 0	1 0	0 11	...	0 9					
T	...	...	...	...	...	...	...	...	0 6	0 6	0 5	...	0 4					
U	...	...	...	...	...	...	...	...	0 1	0 1	0 $0\frac{7}{8}$	...	0 $0\frac{7}{8}$					
X	...	...	...	...	...	...	...	...	0 6	0 6	0 5	...	0 4					
Y	...	...	...	...	...	...	...	...	3 2	3 2	3 0	...	2 9					
Z	...	...	...	...	...	...	...	...	0 1	0 1	0 1	...	0 $0\frac{3}{4}$					
A	...	...	...	...	...	...	...	...	0 $0\frac{7}{8}$	0 $0\frac{7}{8}$	0 $0\frac{3}{4}$	...	0 $0\frac{3}{4}$					
B	...	...	...	...	...	...	...	...	1 1	1 0	1 0	...	0 10					
C	...	...	...	...	...	...	...	...	3 8	3 7	3 6	...	3 0					
D	...	...	...	...	...	...	...	...	1 2	1 2	1 1							
E	...	...	...	...	...	...	...	...	1 4	1 4	1 4							
F	...	...	...	...	...	...	...	...	1 6	1 6	1 5							
G	...	...	...	...	...	...	...	...	1 9	1 9	1 8							
H	...	...	...	...	...	...	...	...	0 1	0 1	0 1							
I	...	...	...	...	...	...	...	...	0 4	0 4	0 4							
									See Gun Deck.									
K	...	...	...	...	...	...	...	...	1 3	1 3	1 2							
L	...	...	...	...	...	...	...	...	1 2	1 2	1 1							
M	...	...	...	...	...	...	...	...	*three*	*three*	*two*	...	*two*					
N	...	...	...	...	...	...	...	...	*two*	*two*	*one*	...	*one*					
O	...	...	...	...	...	...	...	...	0 8	0 8	0 8	...	0 $6\frac{1}{2}$					
P	...	...	...	...	...	...	...	...	0 6	0 6	0 $5\frac{1}{2}$	...	0 5					

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
Middle Deck—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Half Beams { Of fir, abaft the mizen-mast room { *broad...*	0 10½	0 10	...	...	...	..	...	...	...	...	A
deep....	0 8	0 7	...	...	...	...	...	...	...	...	B
Ledges { *broad...*	0 5½	0 5	...	...	...	...	...	...	...	...	C
deep....	0 5	0 4½	...	...	...	...	...	...	...	...	D
Coamings. { To the hatchways, and to extend the whole length of ladderways, &c. { *thick, lower side*	0 8	0 7½	...	...	...	...	...	...	...	...	E
upper side......	0 7	0 6½	...	...	...	...	...	...	...	...	F
above the deck	0 10	0 10	...	...	...	...	...	...	...	...	G
Head Ledges ... *thick...*	0 7	0 6½	...	...	...	...	...	...	...	...	H
deep....	1 4	1 4	...	...	...	...	...	...	...	...	I
Or round up more than the beam in their length	0 3	0 3	...	...	...	...	...	...	...	...	K
Three bolts in each ... *diameter...*	0 0⅞	0 0⅞	...	...	...	...	...	...	...	...	L
Gratings.—Ledges of fir ... *broad...*	0 3	0 3	...	...	...	...	...	...	...	...	M
deep....	0 3½	0 3½	...	...	...	...	...	...	...	...	N
Battens, of oak ... *broad...*	0 3	0 3									
thick....	0 0¾	0 0¾									
Waterways ... *thick....*	0 5	0 4	...	...	...	...	...	...	...	...	O
Broad (or broader clear of sap)	0 11	0 11	...	...	...	...	...	...	...	...	P
Bearded back	0 0½	0 0½	...	...	...	...	...	...	...	...	Q
Flat of the Deck.—To be of Dantzick deal, *thick....*	0 3	0 3	...	...	...	...	...	...	...	...	R
Except next the waterways. There English oak plank, *number of strakes*	*five*	*five*	Same forward under the galley.					...	...	...	S
Two binding strakes on each side, *thick....*	0 4	0 4									
One strake in midships to pillar on	0 4	0 4	...	...	...	...	...	...	...	...	T
Spirketting on each side, *strakes in number*	*two*	*two*	...	...	...	...	...	...	...	...	U
Breadth from the waterways to the sills, and *thick lower edge......*	0 6½	0 6	...	...	...	...	...	...	...	...	X
upper edge thick......	0 6½	0 6	...	...	...	...	...	...	...	...	Y
One bolt in the timber next the butt, and two in each lower sill ... *diameter......*	0 0⅞	0 0⅞	...	...	...	...	...	...	...	...	Z
Stuff between the ports ... *thick......*	0 4½	0 4	...	...	...	...	...	...	...	...	A
Breasthook.—Between decks { *sided......*	1 2	1 1	...	...	...	...	...	...	...	...	B
length.....	18 0	17 0	...	...	...	...	...	...	...	...	C
Breastwork between decks, *bolts in number......*	13	13	...	...	...	...	...	...	...	...	D
diameter......	0 1⅜	0 1⅜	...	...	...	...	...	...	...	...	E
If iron to weigh ... *cwt.*	...	...	...	...	...	...	...	...	...	...	F
Standards.—On each side, *in number*	*six*	*five*	...	...	...	...	...	...	...	...	G
Those of wood well grown, *and sided*	1 0	0 11½									
Those of iron to weigh each ... *cwt.*	4 0 0	3 2 0	...	...	...	...	...	...	...	...	H
Arm next the side long, within two inches of the beams above, and *thwartship arm*	4 6	4 3	...	...	...	...	...	...	...	...	I
Bolts, in number ... *side arm.........*	*five*	*five*	...	...	...	...	...	...	...	...	K
thwartship arm.........	*four*	*four*	...	...	...	...	...	...	...	...	L
diameter...............	0 1⅜	0 1⅜	...	...	...	...	...	...	...	...	M
Iron Standards.—Against the bows, on each side, weight of each ... *cwt.*	...	...	...	...	...	...	...	...	...	...	N
Bolts, in number ... *in side arm.........*	...	...	...	...	...	...	...	...	...	...	O
thwartship arm.....	...	...	...	...	...	...	...	...	...	...	P
diameter............	...	...	...	...	...	...	...	...	...	...	Q
Wood, and iron standards to be fayed upon sholes of English oak plank ... *thick.........*	0 3	0 3									
Transom.—Under the lights { *deep..........*	0 8	0 8	...	...	...	...	...	...	...	...	R
broad.........	1 2	1 2	...	...	...	...	...	...	...	...	S
Knee'd at each end, with one iron knee, weight ... *cwt.*	2 3 0	2 2 0	...	...	...	...	...	...	...	...	T
Bolts, *in number.........*	*eight*	*eight*	...	...	...	...	...	...	...	...	U
diameter........	0 1¼	0 1¼	...	...	...	...	...	...	...	...	X
Pillars—To have one Pillar under each beam { *square, upper end*	0 8	0 7	...	...	...	...	...	...	...	...	Y
.... *lower end*	0 9	0 8	...	...	...	...	...	...	...	...	Z
Port Lids—Every Middle-deck port to be fitted with a substantial lid.											

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	...	...	...	...	...	...	...	...	0 9	0 9	0 9	...	0 8					
B	...	...	...	...	...	...	...	...	0 5	0 5	0 5	...	0 5					
C	...	...	...	...	...	...	...	...	0 5	0 5	0 $4\frac{1}{2}$	...	0 4					
D	...	...	...	...	...	...	...	...	0 4	0 4	0 $3\frac{1}{2}$	...	0 3					
E	...	...	...	...	...	...	...	...	0 7	0 7	0 7	...	0 6					
F	...	...	...	...	...	...	...	...	0 6	0 6	0 6	...	0 5					
G	...	...	...	...	...	...	...	...	0 9	0 9	0 9	...	0 7					
H	...	...	...	...	...	...	...	...	0 6	0 6	0 6	...	0 5					
I	...	...	...	...	...	...	...	...	1 2	1 2	1 2	...	1 0					
K	...	...	...	...	...	...	...	...	0 2	0 2	0 2	...	0 2					
L	...	...	...	...	...	...	...	...	0 $0\frac{7}{8}$	0 $0\frac{7}{8}$	0 $0\frac{7}{8}$	...	0 $0\frac{3}{4}$					
M	...	...	...	...	...	...	Hatches {		0 3	0 3	0 3	...	0 3					
N	...	...	...	...	...	...			0 $3\frac{1}{2}$	0 $3\frac{1}{2}$	0 $3\frac{1}{2}$	...	0 $3\frac{1}{2}$					
O	...	...	...	...	...	...	...	...	0 4	0 4	0 4	...	0 4					
P	...	...	...	...	...	...	...	...	0 11	0 11	0 11	...	0 11					
Q	...	...	...	...	...	...	...	...	0 $0\frac{1}{2}$	0 $0\frac{1}{2}$	0 $0\frac{3}{8}$	...	0 $0\frac{1}{4}$					
R	...	...	...	...	...	...	...	...	0 3	0 3	0 3	...	0 $2\frac{1}{2}$					
S	...	...	...	...	...	...	...	...	*four*	*four*	*three*	...	*three*					
T	...	...	...	...	...	...	...	...	0 4	0 4	0 4	...	0 4					
U	...	...	...	...	...	...	...	...	*two*	*two*	*two*	...	*two*					
X	...	...	...	...	...	...	...	...	0 4	0 4	0 4	...	0 3					
Y	...	...	...	...	...	...	...	...	0 4	0 4	0 4	...	0 3					
Z	...	...	...	...	...	...	...	...	0 $0\frac{7}{8}$	0 $0\frac{7}{8}$	0 $0\frac{3}{4}$	...	0 $0\frac{3}{4}$					
A	...	...	...	...	...	...	...	...	0 3	0 3	0 3	...	0 $2\frac{1}{2}$					
B	...	...	...	...	...	...	...	...	1 1	1 1	1 0	...	0 10					
C	...	...	...	...	...	...	...	...	17 0	17 0	16 0	...	15 0					
D	..	...	...	...	...	...	...	...	13	13	*eleven*	...	*nine*					
E	...	...	...	...	...	...	...	...	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$	...	0 1					
F	...	...	...	...	...	...	...	...	8 2 0	8 1 0	8 0 0	...	5 3 0					
G	...	...	...	...	...	...	...	...	*five*	*five*	*five*	...	*four*					
H	...	...	...	...	...	...	...	...	3 0 0	2 3 0	2 1 10	...	2 0 0					
I	...	...	...	...	...	...	...	...	4 3	4 3	4 2	...	4 0					
K	...	...	...	...	...	...	...	...	*four*	*four*	*four*	...	*four*					
L	...	...	...	...	...	...	...	...	*four*	*four*	*four*	...	*four*					
M	...	...	...	...	...	...	...	...	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$	0 $1\frac{1}{8}$	...	0 $1\frac{1}{8}$					
N	...	...	...	...	...	...	...	...	3 3 14	3 3 0	3 2 0	...	2 3 0					
O	...	...	...	...	...	...	...	...	*four*	*four*	*four*	...	*four*					
P	...	...	...	...	...	...	...	...	*three*	*three*	*three*	...	*three*					
Q	...	...	...	...	...	...	...	...	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$	0 $1\frac{1}{4}$	...	0 $1\frac{1}{8}$					
R	...	...	...	...	...	...	...	...	0 7	0 7	0 $6\frac{1}{2}$	...	0 6					
S	...	...	...	...	...	...	...	...	1 0	1 0	0 11	...	0 9					
T	...	...	...	...	...	...	...	...	2 1 14	2 1 0	2 0 0	...	1 2 6					
U	...	...	...	...	...	...	...	...	*seven*	*seven*	*seven*	...	*six*					
X	...	...	...	...	...	...	...	...	0 $1\frac{1}{8}$	0 $1\frac{1}{8}$	0 $1\frac{1}{8}$	...	0 1					
Y	...	...	...	...	...	...	...	...	0 6	0 6	0 6	...	0 5					
Z	...	...	...	...	...	...	...	...	0 7	0 7	0 7	...	0 6					

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
Middle Deck—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
English oak linings.........................*thick*	0 1⅛	0 1⅛	...	...	...	...	...	...	...	...	A
Stops of the ports not less than..................	0 3	0 3	...	...	...	...	...	...	...	...	B
Scuttles in the Ports, and hanging of ditto similar to Lower-gun Deck, which see.											
Ports aft. See Stern.											
Scuttles—To have a scuttle in the clear.............*deep*	...	...	...	...	...	...	...	...	...	...	C
Between each port under the clamps, *fore and aft*	...	...	...	...	...	...	...	...	...	...	D
Iron Work—To each port ring bolts............*in number*	*four*	*four*	...	...	...	...	...	...	...	...	E
Eyebolts..............................*in number...*	*two*	*two*	...	...	...	...	...	...	...	...	F
The said bolts..........................*diameter..*	0 1¼	0 1¼	..	...	...	...	...	...	...	...	G
Diameter of the rings in clear	0 5½	0 5	...	...	...	...	...	...	...	...	H
of the eyes in clear	0 2¼	0 2	...	...	...	...	...	...	...	...	I
Muzzle-lashing eyebolts, over each port two *diameter*	0 1¼	0 1¼	...	...	...	...	...	...	...	...	K
Eyes in the clear	0 3	0 3	...	...	...	...	...	...	...	...	L
Training eyebolts, one between every port, *diameter*	0 1¼	0 1¼	...	...	...	...	...	...	...	...	M
Eyes in the clear	0 2¼	0 2	...	...	...	...	...	...	...	...	N
Ringbolt abreast each port..............*diameter*	0 1⅛	0 1⅛	...	...	...	...	...	...	...	...	O
In the deck.......................*ring in the clear*	0 3½	0 3¼	...	...	...	...	...	...	...	...	P
Tricing eyebolts in the beams..........*diameter*	...	...	...	...	...	...	...	...	...	...	Q
Eyes in the clear	...	...	...	...	...	...	...	...	...	...	R
number	...	...	...	...	...	...	...	...	...	...	S
Eyebolts* one on each side in every other beam, abaft the foremast in the side.......... { ....*diameter*	...	...	...	...	...	...	...	...	...	...	T
eyes in the clear	...	...	...	...	...	...	...	...	...	...	U
Eyebolts in the clamps for lashing up oars, &c.............................. { *number..*	...	...	...	...	...	...	...	...	...	...	X
diameter	...	...	...	...	...	...	...	...	...	...	Y
Eyes in the clear	...	...	...	...	...	...	...	...	...	...	Z
Stopper Bolts (see Gun Deck)...........*diameter*	...	...	...	...	...	...	...	...	...	...	A
Rings in the clear	...	...	...	...	...	...	...	...	...	...	B
Galley—Cants..........................*asunder in the clear*	9 6	9 0									
deep	0 6	0 6									
Covered with lead to the foot square.........*lbs.*	*nine*	*nine*									
Bulkhead—Deal......................................*thick*	0 1¼	0 1¼	...	...	...	...	...	...	...	...	C
Stantions of oak..............................*square*	0 5	0 4¾	...	...	...	...	...	...	...	...	D
Scuppers—On each side.............................*number*	*six*	*six*	...	...	...	...	...	...	...	...	E
diameter in the clear	0 4	0 4	...	...	...	...	...	...	...	...	F
Shot Racks, Hammock Racks, and Tricing Battens, as Gun Deck.											
UPPER DECK.											
Upper Deck Clamps.											
Strakes...................................*in number*	*one*	*one*	*one*	*one*	*one*	*one*	*two*	*two*	*two*	*two*	G
Thick............................ *at the upper edge*	0 6	0 6	0 7	0 7	0 6	0 6	0 6	0 6	0 6	0 5	H
lower edge	0 5	0 5	0 5½	0 5½	0 5	0 5	0 5	0 5	0 5	0 4	I
Scarphs..*long*	4 9	4 9	4 6	4 6	4 4	4 4	3 10	3 10	3 10	3 6	K
Bolted at the lips with one bolt..........*diameter*	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	L
Upper strake..................................*broad* }	If in two to be tabled or coaked. {					...	...	...	...	...	M
Lower strake..................................*broad* }						...	2 4	2 4	2 2	2 2	N
Deck Hook...*sided*	1 1½	1 1	1 0½	1 0½	1 0	0 11½	0 11	0 11	0 11	0 11	O
(Or as long as can be gotten)...............*length*	19 6	19 0	18 0	17 0	16 6	16 0	16 0	16 0	16 0	15 6	P
Bolts..*number*	*fifteen*	*fifteen*	*thirteen*	*thirteen*	*thirteen*	*eleven*	*eleven*	*eleven*	*eleven*	*eleven*	Q
diameter	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	R
Ekeings to Deck-hook..............*deep or sided*	1 0	0 11	0 10	0 10	0 10	0 9	0 8	0 8	0 8	0 8	S
Bolts.......................................*number...*	*seven*	*seven*	*six*	*six*	*five*	*five*	*four*	*four*	*four*	*four*	T
diameter..	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	U
Beams—To round up..	0 8	0 8	0 8	0 8	0 7½	0 7½	0 8	0 7	0 7	0 7	X

* Hooks and cleats in the sides of the beams, for hauling

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS. 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
A	...	...	...	...	...	...	...	...	0 1	0 1	0 1							
B	...	...	...	...	...	...	...	...	0 2½	0 2½	0 2½							
C	...	...	...	...	...	...	...	...	0 5	0 5	0 5	...	0 5					
D	...	...	...	...	...	...	...	...	0 9	0 9	0 9	...	0 9					
E	...	...	...	...	...	...	...	...	two	two	two	...	two					
F	...	...	...	...	...	...	...	...	two	two	two	...	two					
G	...	...	...	...	...	...	...	...	0 1⅛	0 1⅛	0 1⅛	...	0 1					
H	...	...	...	...	...	...	...	...	0 4¾	0 4¾	0 4¾	...	0 4					
I	...	...	...	...	...	...	...	...	0 2	0 2	0 2	...	0 1¾					
K	...	...	...	...	...	...	...	...	0 1¼	0 1¼	0 1¼	...						
L	...	...	...	...	...	...	...	...	0 2¾	0 2¾	0 2¾	...						
M	...	...	...	...	...	...	...	...	0 1⅛	0 1⅛	0 1⅛	...	0 1					
N	...	...	...	...	...	...	...	...	0 2	0 2	0 2	...	0 1¾					
O	...	...	...	...	...	...	...	...	0 1	0 1	0 1	...	0 0⅞					
P	...	...	...	...	...	...	...	...	0 3	0 3	0 3	...	0 2⅜					
Q	...	...	...	...	...	...	...	...	0 1⅛	0 1⅛	0 1⅛	...	0 1					
R	...	...	...	...	...	...	...	...	0 2½	0 2½	0 2¼	...	0 2					
S	...	...	...	...	...	...	...	...	twenty	twenty	twenty	...	sixteen					
T	...	...	...	...	...	...	...	...	0 1⅛	0 1⅛	0 1⅛	...	0 1					
U	...	...	...	...	...	...	...	...	0 2¼	0 2¼	0 2¼	...	0 2					
X	...	...	...	...	...	...	...	...	twenty	twenty	twenty	...	twenty					
Y	...	...	...	...	...	...	...	...	0 1⅛	0 1⅛	0 1⅛	...	0 1					
Z	...	...	...	...	...	...	...	...	0 2¼	0 2⅛	0 2	...	0 2					
A	...	...	...	...	...	...	...	...	0 1⅝	0 1⅝	0 1½							
B	...	...	...	...	...	...	...	...	0 6¼	0 6¼	0 6							
C	...	...	...	...	...	...	...	...	0 2	0 2	0 2							
D	...	...	...	...	...	...	Beam	{ sided	0 10	0 10	0 10							
								{ deep	0 8½	0 8½	0 8½							
E	...	...	...	...	...	...	...	...	six	six	six							
F	...	...	...	...	...	...	...	...	0 4	0 4	0 4							
G	two	two	two	two	two	one	one	one	two	two	two	two	two	two	two	two	one	one
H	0 5	0 4½	0 4	0 3	0 5½	0 3½	0 4	0 3½	0 4	0 4	0 4	0 4	0 4	0 3½	0 3	0 3	0 3	0 3
I	0 4	0 3	0 3	0 2½	0 4	0 2½	0 3	0 3	0 4	0 4	0 4	0 4	0 4	0 3½	0 3	0 3	0 3	0 3
K	3 6	3 6	3 4	2 9	4 0	2 9	2 9	2 9	4 0	4 0	4 0	3 6	3 6	3 0	3 0	2 9	2 9	2 9
L	0 0¾	0 0¾	0 0¾	...	...	...	...	...	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾					
M	...	...	1 2 }	...	...	1 1	1 2	1 1	}									
N	2 0	2 0	1 1 }	1 10	1 10				} 1 4	1 4	1 4	2 0	1 3	1 10	1 8	1 8	1 0	0 11
O	0 10½	0 10	0 9	0 7	0 10	0 7	0 8	0 7½	1 0	1 0	1 0	0 11	0 10	0 9	0 8½	0 8	0 8½	0 7
P	15 0	14 6	13 6	10 6	13 6	11 0	11 6	11 0	16 0	16 0	16 0	14 6	13 6	12 6	12 6	11 6	12 0	9 6
Q	eleven	eleven	eleven	seven	nine	nine	nine	nine	thirteen	thirteen	eleven	eleven	nine	nine	nine	nine	seven	seven
R	0 1¼	0 1¼	0 1⅛	0 1	0 1⅛	0 1	0 1	0 1	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0¾
S	0 7	0 7	0 7	...	...	...	...	...	0 10	0 10	0 9	0 8	0 7					
T	three	three	three	...	...	...	...	...	five	five	five	four	four					
U	0 1⅛	0 1¼	0 1	...	...	...	...	...	0 1⅛	0 1⅛	0 1	0 0⅞	0 0⅞					
X	0 7	0 6½	0 6	0 6	0 6	0 6½	0 6¾	0 6½	0 9	0 9	0 8	0 7	0 7	0 5½	0 6¾	0 5	0 7	0 6

up and belaying the ports, as to the Gun Deck.

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 100	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
UPPER DECK— *continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Plank ... *thick*	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	A
Height from the upperside of the plank to the upperside of the quarter-deck beam in midships ... *afore*	6 10	6 8	6 10	6 10	6 8	6 7	6 6	6 5	6 5	6 4	B
... *abaft*	7 1	6 11	7 0	7 0	6 8	6 2	6 10	6 8	6 7	6 7	C
Height from the upper side of the plank to the upperside of the Roundhouse beam in midships ... *afore*	...	...	...	...	...	...	...	...	...	...	D
... *abaft*	...	...	...	...	...	...	...	...	...	...	E
Height from the upperside of the plank to the upper side of the forecastle beam in midships ... *afore*	6 7	6 6	6 7	6 7	6 5	6 3	6 4	6 5	6 2	6 1	F
... *abaft*	6 7	6 6	6 7	6 7	6 5	6 2	6 4	6 5	6 2	6 1	G
Depth of the waist from the upperside of the plank at the lowest place ...	6 8	6 8	6 10	6 9	6 0	5 9	6 10	6 8	6 9	6 9	H
Height from the upper edge of the rabbet of the keel to the upperside of the beam in the middle line ... *afore* ...	...	...	...	...	...	...	...	...	...	...	I
midships	...	...	...	...	...	...	...	...	...	...	K
abaft ...	...	...	...	...	...	...	...	...	...	...	L
FALL.—Length of the fall or rise in some vessels, afore the after perpendicular ...	...	...	...	...	...	...	...	...	...	...	M
Length abaft the foremost perpendicular for galley forward ...	...	...	...	...	...	...	...	...	...	...	N
Depth of the fall or rise ...	...	...	...	...	...	...	...	...	...	...	O
Flat of the fall ... *thick* ...	...	...	...	...	...	...	...	...	...	...	P
Height from the plank to the port sills ...	1 11	1 11	2 0	2 0	1 11	1 9	2 2	2 1	2 2	1 9	Q
Ditto on the fall ...	...	...	...	...	...	...	...	...	...	...	R
PORTS ... *deep* ...	2 9	2 8	2 10	2 8	2 8	2 7	2 7	2 6	2 5	2 4	S
fore and aft ...	3 0	2 10	3 0	2 10	2 10	2 8	3 0	3 0	2 10	2 6	T
Distance from each other ...	8 1	8 3	8 0	8 1	7 2	8 3	7 2	7 2	7 2	6 9	U
number ...	32	32	32	30	28	24	30	30	26	26	X
number on the fall ...	...	...	...	...	...	...	...	...	...	...	Y
Foreside of the foremost port, abaft the foremost perpendicular ...	11 6	11 9	11 1	13 1	11 6	12 6	6 4	3 0 / 11 9	10 4	10 3	Z
Aftside of the after port, afore the after perpendicular ...	2 2	5 10	6 3	6 9	8 0	7 6	8 4	5 11	4 6	5 1	A
SILLS ... Lower sills, *deep* ...	0 7	0 7	0 7	0 6½	0 6	0 6	0 6	0 6	0 6	0 6	B
Upper sills, *deep* ...	0 6	0 6	0 6	0 5½	0 5	0 5	0 5	0 5	0 5	0 5	C
BEAMS ... *sided* ...	1 1½	1 0¾	1 2	1 1½	1 1	1 0½	1 1½	1 1	1 1	1 0½	D
moulded ...	1 0	0 11	1 1	1 0	0 11½	0 11	0 11½	0 11	0 11	0 9½	E
number ...	33	32	30	28	27	25	30	27	27	26	F
or asunder about ...	...	...	...	...	...	...	...	...	...	...	G
Beam next the fore and main mast, *sided* ...	...	...	...	...	...	...	...	...	...	...	H
Beams of the fall or rise, *sided* ...	...	...	...	...	...	...	...	...	...	...	I
moulded ...	...	...	...	...	...	...	...	...	...	...	K
number ...	...	...	...	...	...	...	...	...	...	...	L
Bolts in the scarphs, *number in each* ...	*nine*	*nine*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*seven*	M
square iron, *diameter* ...	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	N
TRANSOM. Deep or sided ...	0 11½	0 11	0 11	0 11	0 10	0 10	0 9	0 8½	0 8½	0 8	O
Moulded middle (or broader) ...	1 2	1 2	1 1	1 1	1 0	1 0	0 11	0 11	0 11	0 11	P
at the ends ...	1 0	1 0	0 11	0 11	0 10	0 10	0 10	0 10	0 9	0 9	Q
Scored on and bolted through each counter timber: bolt's *diameter* ...	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	R
Knee'd at each end with a knee to cast before the second beam from aft ... *sided* ...	0 9	0 8	0 8	0 8	0 7½	0 7	0 7	0 7	0 7	0 6½	S
thwartship arm, *long*	4 9	4 9	4 7	4 6	4 4	4 2	4 0	4 0	4 0	4 0	T
Bolts, number in fore and aft arm ...	*five*	*five*	*five*	*five*	*five*	*four*	*four*	*four*	*four*	*four*	U
number in thwartship arm ...	*four*	*four*	*four*	*four*	*four*	*three*	*three*	*three*	*three*	*three*	X
diameter ...	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 1	Y
If iron, to weigh about ... *cwt.*	3 0 0	2 3 9	...	...	...	...	...	...	...	...	Z
FILLINGS abaft the transoms, of oak, *deep* ...	0 9	0 9	0 8	0 8	0 7	0 7					
KNEES.—The beams to be knee'd at each end with hanging and 1 lodging knee ... hanging knees, *sided*	0 9	0 8½	0 9	0 9	0 8	0 8	0 9	0 8½	0 8½	0 8	A
hanging arm, *long* ...	5 6	5 6	5 6	5 6	5 4	5 3	5 0	5 0	5 0	4 10	B

SCANTLINGS OF SHIPS OF EACH CLASS.

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	0 3	0 3	0 3	0 2½	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 2½	0 2½	0 2	0 2½	0 2
B	6 4	6 4	5 10	...	5 10													
C	6 6	6 6	6 6	...	6 5													
D	...	...	...	...	...	...	...	...	6 4	6 4	6 4	6 3	...	5 9				
E	...	...	...	...	...	...	...	...	6 6	6 6	6 6	6 9	...	6 1				
F	6 0	6 0	5 8	4 4	4 11	...	...	...	6 0	6 0	6 0	5 7	...	5 3				
G	6 0	6 0	5 10	4 4	4 11	...	...	...	6 0	6 0	6 0	5 7	...	4 9				
H	6 6	6 2	6 1	3 4	4 1	3 6	4 5	4 1	3 10	3 10	3 10	1 6	0 5	3 0	3 9	0 9	0 3	0 5
I	...	...	16 8	...	15 5	13 6	17 0	14 5	...	...	...	...	...	...	12 5	9 3	17 2	11 6
K	...	...	15 9	...	13 9	12 6	14 6	12 9	...	...	...	...	...	...	12 6	9 0	16 6	10 9
L	...	...	16 8	...	14 0	16 1	19 2	14 3	...	...	...	...	...	...	15 8	15 0	20 9	13 1
																	rise	*rise*
M	...	...	...	...	21 9	...	...	...	...	...	...	...	...	...	...	23 6	37 0	20 3
N	...	...	...	...	...	...	...	...	16 0	15 10	15 0							
O	...	...	...	...	1 2	...	...	...	2 10	2 10	2 8	...	...	...	...	1 9	1 0	0 8
P	...	...	...	...	0 2½	...	...	...	0 3	0 3	0 3	...	...	...	...	0 2	0 3	0 2
Q	1 9	1 8	1 6	1 2	1 6	1 6	1 9	1 9	1 6	1 4	1 4	...	...	1 0	1 4			
R	...	...	...	...	1 10													
S	2 3	2 3	2 2	1 6	2 0	1 5	2 1	1 10	2 0	2 2	2 0	2 0	2 0	1 10	1 8	1 9		
T	2 6	2 6	2 5	1 6	2 4	2 0	2 1	2 0	2 5	2 5	2 4	2 4	2 4	2 3	2 0	1 10		
U	6 8	6 11½	6 11½	7 8	9 0	8 4	5 9	6 7	8 3	8 0	8 3	7 6	6 0	7 6	8 3	6 0		
X	24	24	20	10	12	12	24	16	26	24	24	22	20	20	14	16		
Y	...	...	...	...	*four*													
Z	10 8	4 6	6 6	11 9	3 9	9 0	7 0	9 0	21 9	22 0	22 0	14 6	31 3	6 4	9 0	12 9		
													abaft it			*abaft it*		
A	8 3	8 2	12 0	...	2 3	14 10	11 0	6 10	14 3	13 6	13 3	12 6	2 3	8 3	5 6	0 4		
B	0 5½	0 5½	0 5	0 4	0 5	0 4	0 4	0 4	0 6	0 6	0 6	0 6	0 5	0 4	0 4	0 4		
C	0 4½	0 4½	0 4	0 3	0 4	0 3	0 3	0 3	0 5	0 5	0 5	0 5	0 4	0 3				
D	0 11½	0 10½	0 10	0 8¼	1 0	0 9¼	0 11	0 10	0 10½	0 10	0 9	0 9	0 8½	0 9	0 8	0 8	0 8½	0 7
E	0 9	0 8½	0 8	0 6¾	1 0	0 7	0 8	0 8	0 8½	0 8	0 7	0 7	0 6½	0 7	0 6	0 6	0 7	0 5½
F	24	22	14	14	12	16	25	16	37	37	34	27	25					
G	...	...	...	...	...	...	...	...	...	...	...	...	...	3 4	3 4	3 4	3 4	3 4
H	...	...	...	...	...	...	...	...	1 1	1 0½	1 0	0 11	0 10	0 10	0 9	0 9	0 10	0 9
I	...	...	...	...	0 9½	...	...	...	0 9	0 9	0 8½	0 8	...	...	...	...	0 7	0 6
K	...	...	...	...	0 8½	...	...	...	0 7	0 7	0 6½	0 6	...	...	...	...	0 6	0 5
L	...	...	...	...	*four*	...	...	...	*five*	*five*	*four*	*four*	...	...	...	...	*ten*	*seven*
M	*seven*	*seven*	*six*	...	*six*	...	...	...	*eight*	*eight*	*eight*	*seven*	*seven*	*six*				
N	0 0⅞	0 0¾	0 0¾	...	0 0¾	...	...	...	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾				
O	0 7½	0 7½	0 7	0 6	...	0 6	0 6	0 6	0 8½	0 8½	0 8	0 7½	0 7	0 6½	0 6	0 6	0 6	0 5¾
P	0 10	0 10	0 9½	0 9	...	0 9	0 9	0 9	1 0	1 0	1 0	0 11	0 10	0 10	0 9	0 7	0 8	0 6½
Q	0 8	0 8	0 7	0 6	...	0 7	0 7	0 7	0 11	0 11	0 10	0 9	0 9	0 8	0 7	0 6	0 6	0 5¾
R	0 0⅞	0 0⅞	0 0¾	0 0¾	...	0 0¾	0 0¾	0 0¾	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾		
S	0 6½	0 6	0 6	0 5	...	0 5	0 5	0 5										
T	3 10	3 9	3 7	3 6	...	3 6	3 6	3 6	4 9	4 9	4 9	4 6	4 4	4 3	4 0	4 0		
U	*four*	*four*	*four*	*three*	...	*three*	*three*	*three*	*five*	*five*	*five*	*four*	*four*	*four*	*four*	*four*		
X	*three*	*three*	*three*	*three*	...	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*		
Y	0 0⅞	0 0⅞	0 0⅞	0 0¾	...	0 0¾	0 0¾	0 0¾	0 1⅛	0 1⅛	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 0¾		
Z	...	...	...	...	...	...	...	...	2 2 0	2 2 0	2 1 14	1 2 14	1 2 0	1 1 0	1 0 14			
A	0 7½	0 7	0 6½	0 5	0 7¼	0 5½	0 6½	0 5½	0 8	0 8	0 7¾	0 6½	0 6	0 5¾	0 5½	0 5	0 5	0 4¾
B	4 9	4 8	4 6	4 0	4 0	3 9	3 9	3 9	4 6	4 0	4 0	4 0	4 0	3 9	3 7	3 6	3 6	3 0

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
Upper Deck—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Thwartship arm, *long*	4 2	4 0	3 9	3 9	3 9	3 9	3 9	3 8	3 8	3 7	A
Number of bolts in the Hanging arm............	*five*	*five*	*five*	*five*	*five*	*five*	*five*	*five*	*five*	*five*	B
Thwartship arm.........	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	C
bolt's diameter	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1¼	0 1¼	0 1¼	0 1¼	D
Iron Hanging Knees to weigh about.........*cwt.*	3 0 0	2 3 0	3 0 0	2 3 0	2 2 14	2 2 0	2 1 14	2 1 0	2 1 0	2 0 0	E
Lodging Knees { ....*sided*	0 8	0 7¾	0 8	0 8	0 7½	0 7	0 8	0 8	0 8	0 7½	F
Lodging Knees { ....*thwartships arm, long*	4 9	4 7	4 3	4 3	4 3	4 3	4 3	4 2	4 2	4 0	G
Fore and aft arm length sufficient for bolts at least	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	H
diameter	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1¼	0 1¼	0 1¼	0 1¼	I
Iron Lodging Knees, to weigh about.........*cwt.*	2 3 0	2 2 14	2 3 0	2 2 14	2 2 0	2 1 14	2 1 0	2 0 14	2 0 14	1 3 14	K
Hatchways—To be over those on the Lower-deck, viz. the Main, Fore, and After Hatchways, and to be of the same dimensions.											
Ladderways—..	...	...	...	Afore Main Hatchw.			{ 4 8	4 8	4 8	4 8	L
fore and aft	4 8	4 8	4 6	4 6	4 4	4 0	{ 3 9	3 9	3 9	3 9	M
thwartships	4 8	4 8	4 6	4 6	4 4	4 4	5 3	5 3	5 3	5 2	N
Foreside abaft the centre of the Fore-mast	Next room afore the Main, and abaft the Fore Hatchway.... }			...	...	31 3	Abaft Fore Hatchway.			...	O
Companion—..................................*fore and aft*	16 0	16 0	14 6	14 6	12 9	10 9	9 0	8 6	8 3	8 3	P
thwartships	5 0	5 0	4 10	4 10	4 9	4 8	4 8	4 8	4 8	4 8	Q
Foreside abaft the centre of the Main-mast......	33 0	31 0	30 0	27 0	23 0	17 3	25 0	25 0	24 3	23 0	R
Hatches and Hatchways of small ships.. } Main hatch......*fore and aft*	...	...	...	...	...	...	...	...	...	...	S
Hatches and Hatchways of small ships.. } ....*thwartships*	...	...	...	...	...	...	...	...	...	...	T
Aftside afore the centre of the Main-mast........	...	...	...	...	...	...	...	...	...	...	U
Fore Hatchway..................................*fore and aft*	...	...	...	...	...	...	...	...	...	...	X
thwartships	...	...	...	...	...	...	...	...	...	...	Y
Foreside of it abaft the centre of the Fore-mast..	...	...	...	...	...	...	...	...	...	...	Z
After Hatchway..............................*fore and aft*	...	...	...	...	...	...	...	...	...	...	A
thwartships	...	...	...	...	...	...	...	...	...	...	B
Foreside of it, abaft the aftside of Main Hatch..	...	...	...	...	...	...	...	...	...	...	C
Top Riders—Number on each side........................	13	13	12	12	12	11	10	10	9	9	D
sided...	1 1	1 1	1 0½	1 0½	1 0	1 0	0 11½	0 11½	0 11½	0 11	E
moulded	1 0	1 0	0 11½	0 11½	0 11	0 11	0 10½	0 10½	0 10½	0 10	F
In length from the underside of the Gunwale in midships, and underside of the Quarter-deck and Forecastle beams, forward in frigates. To stand as diagonally as possible, and to have two bolts through the beams they face on.											G
Bolted with bolts ....*in number*	11	11	*nine*	*nine*	*nine*	*nine*	*nine*	*nine*	*nine*	*nine*	H
diameter	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	I
Partners—Mainmast Partners........................*broad*	1 9	1 8	1 7	1 6	1 5	1 5	1 4	1 3	1 3	1 2	K
And fitted with cross-chocks, &c. as those on the Gun-deck......... { ....*deep*	1 8	1 7	1 6	1 5	1 4	1 4	1 3	1 2	1 2	1 1	L
Asunder in the clear............	4 3	4 2	4 1	4 0	3 10	3 9	3 6	3 4	3 4	3 2	M
Uppersides above the beam....	0 9	0 9	0 9	0 9	0 8	0 8	0 7	0 6½	0 6½	0 6	N
Fore-mast Partners........ *broad*	1 3	1 2½	1 2	1 2	1 1	1 0½	1 2	1 1½	1 1	1 1	O
..............................*deep..*	1 4	1 3½	1 3	1 3	1 2	1 1½	1 1	1 0½	1 0	1 0	P
Asunder in the clear............	4 1	4 0	3 10	3 10	3 8	3 7	3 4	3 2	3 0	3 0	Q
Uppersides above the beam....	0 8	0 8	0 8	0 8	0 7	0 7	0 6	0 6	0 6	0 6	R
Two bolts in each end ....*diameter*	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	S
Mizen-mast Partners...... ....*thick...*	0 6	0 6	0 5	0 5	0 5	0 5	0 4½	0 4½	0 4½	0 4½	T
broad...	5 6	5 4	5 2	5 0	4 10	4 9	4 7	4 6	4 6	4 4	U
Scored down upon the beams and ledges........	0 1½	0 1½	0 1	0 1	0 1	0 1	0 0¾	0 0¾	0 0¾	0 0¾	X
Fastened with bolts .... *number*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	Y
diameter	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	Z
Step of the Bowsprit—To be of two pieces......*square...*	...	...	...	...	...	...	...	...	...	...	A
Run up to make topsail sheet bitts—*asunder in the clear*..	...	...	...	...	...	...	...	...	...	...	B
Chocks to be thick	...	...	...	...	...	...	...	...	...	...	C
Laps of the chocks thick on the foreside.........	...	...	...	...	...	...	...	...	...	...	D
Bolted by bolts..........................*in number*	...	...	...	...	...	...	...	...	...	...	E
diameter	...	...	...	...	...	...	...	...	...	...	F
Step for the Capstan—............................ *broad....*	...	...	...	...	...	...	1 8	1 8	1 8	1 6	G
deep.....	...	...	...	...	...	...	1 4	1 4	1 4	1 2	H
Upperside above the deck..........................	...	...	...	...	...	...	0 4	0 4	0 4	0 4	I

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	3 6	3 6	3 4	2 9	3 0	2 9	3 0	2 9	3 6	3 6	3 6	3 3	3 0	3 0	2 9	2 9	2 9	2 6
B	*four*	*four*	*four*	*four*	*four*	*three*	*three*	*three*	*four*	*four*	*four*	*four*	*four*	*four*	*three*	*three*	*three*	*three*
C	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*
D	0 1⅛	0 1⅛	0 1	0 0¾	0 1⅛	0 0¾	0 0¾	0 0¾	0 1⅛	0 1⅛	0 1⅛	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾
E	1 3 0	1 2 14	1 2 0	...	...	...	...	...	1 1 14	1 1 14	1 1 0	1 0 14	1 0 0	0 3 14	0 3 0			
F	0 7	0 6½	0 6	0 4½	0 7	0 5	0 6	0 5	...	...	...	...	0 6	0 5½	0 5¼	0 4½	0 5	0 4¼
G	3 9	3 9	3 9	3 0	3 4	3 0	3 3	3 0	3 7	3 7	3 7	3 4	3 1	3 0	3 0	3 0	2 10	2 9
H	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*two*	*two*
I	0 1⅛	0 1⅛	0 1	0 0¾	0 1⅛	0 0¾	0 0¾	0 0¾	0 1⅛	0 1⅛	0 1⅛	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾
K	1 2 14	1 2 0	1 1 0	...	...	...	...	...	1 1 0	1 1 0	1 0 14	1 0 0	0 3 14	0 3 7	0 3 0			
L	4 8	4 8																
M	3 7	3 7	...	...	2 4	2 9	2 9	2 9	1 8	1 8	1 8							
N	5 0	5 0	...	...	4 8	4 8	4 8	4 8	4 6	4 6	4 6							
O	...	...	...	...	8 9	...	...	...	17 9	17 6	17 0							
P	8 0	8 0	7 9	...	2 4	2 10	2 10	2 9										
Q	4 8	4 6	4 4	...	4 2	1 10	1 10	1 9										
R	22 0	19 0	16 6	...	10 7	Over the cabin.												
S	...	...	...	4 9	4 10	5 0	5 1	5 7	...	...	...	...	...	...	5 6	5 6	12 0	9 6
T	...	...	...	3 10	4 6	4 6	4 6	4 8	...	...	...	...	...	...	4 8	4 8	5 6	5 0
U	...	...	...	3 0	13 9	2 9	6 8	...	...	...	...	...	...	...	3 6	3 9	3 0	Abaft 2 6
X	...	...	...	4 1	...	4 2	3 6	4 2										
Y	...	...	...	3 10	...	4 0	3 8	4 0										
Z	...	...	...	11 10	...	8 6	6 11											
A	...	...	...	...	...	2 10	...	2 4										
B	...	...	...	...	...	4 0	...	4 0										
C	...	...	...	...	...	7 8	...	7 6										
D	9	8																
E	0 10½	0 10																
F	0 10	0 9																
G	and aft, to within six inches of the upperside of the Middle-deck in three-decked ships, or Gun-deck in two-decked ships, and Orlop																	
H	*nine*	*nine*																
I	0 1⅛	0 1⅛																
K	1 1	1 0	0 11	1 0	0 11	0 10	1 0	0 11	1 2	1 1	1 0	1 0	0 10	0 10	0 10	0 9	0 10	0 7
L	1 0	0 11	0 11	0 6	0 10	0 7	0 7½	0 7	1 0	1 0	0 11	0 10	0 9	0 8	0 8	0 7	0 8	0 6
M	3 0	2 9	2 4	2 0	2 0	2 0	2 5	2 7	3 7	3 6	3 5	3 0	2 10	2 8	2 4	2 0	2 4	1 10
N	0 6	0 6	0 6	...	0 6	...	...	...	0 6	0 6	0 5	0 5	0 4	0 4	0 4	0 3	0 4	0 3
O	1 0½	1 0	0 11	0 10	0 11	0 9	0 10	...	1 1	1 1	1 0	0 11	0 10	0 10	0 10	0 9	0 9	
P	0 11½	0 11	0 10	0 5½	0 10	0 6	0 6	...	1 0	1 0	0 11	0 10	0 9	0 8	0 8	0 7	0 7	
Q	2 10	2 7	2 0	1 10	1 10	1 11	2 3	...	3 5	3 4	3 3	2 10	2 8	2 6	2 3	1 10	2 2	
R	0 6	0 6	0 6	...	0 6	...	...	...	0 5	0 5	0 5	0 4	0 4	0 4	0 4	0 3	0 3	
S	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 1	0 1	0 0[illegible]	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	
T	0 4	0 4	0 4	0 3	0 4	...	...	...	0 4	0 4	0 4	0 3	0 3	0 3				
U	4 0	3 6	2 9	2 7	3 0	...	...	...	3 2	3 2	3 0	2 10	2 10	2 9				
X	0 0¾	0 0¾	0 0¾	0 0½	0 0¾	...	...	...	0 0¾	0 0¾	0 0¾	0 0⅝	0 0⅝	0 0½				
Y	*eight*	*eight*	*four*	*four*	*four*	...	...	...	*four*	*four*	*four*	*four*	*four*	*four*				
Z	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	...	...	...	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅝				
A	...	...	0 8	0 7	0 7½	0 7	0 7	0 7	...	...	...	...	...	0 8	0 7½	0 6½	...	0 6
B	...	...	2 4	2 0	2 2	1 8	1 8	1 8	...	...	...	...	...	2 2	2 0	1 7	...	1 3
C	...	...	0 6	0 5	0 6	0 6	0 6	0 6	...	...	...	...	...	0 6	0 6	0 6	...	0 5
D	...	...	0 3	0 2½	0 3	0 3	0 3	0 3	...	...	...	...	...	0 3	0 3	0 3	...	0 2½
E	...	...	*four*	*four*	*four*	*four*	*four*	*four*	...	...	...	...	...	*four*	*four*	*four*	...	*four*
F	...	...	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	...	...	...	...	...	0 0¾	0 0¾	0 0¾	...	0 0¾
G	1 6	1 5	1 5	...	1 3	1 2	1 3	1 2	...	...	...	1 4	1 4	1 3	1 3	1 2		
H	1 2	1 2	1 2	...	1 4	1 3	1 4	1 3	...	...	...	1 6	1 5	1 4	1 4	1 3		
I	0 4	0 4	0 4	...	0 6	0 6	0 6	0 6	...	...	...	0 6	0 6	0 6	0 6	0 5		

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
UPPER DECK—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Laps to extend to the further sides of the beams, and to have two bolts through each lap, *diameter*......	...	...	...	...	...	...	0 1⅛	0 1⅛	0 1⅛	0 1⅛	A
Pieces of oak let down on each side of the step, *thick*	...	...	...	...	...	...	0 8	0 8	0 8	0 8	B
broad.........	...	...	...	...	...	...	2 0	2 0	2 0	1 11	C
CAPSTAN-PARTNERS.—Main and fore.........*thick*.........	...	...	0 7	0 7	0 6½	0 6	...	...	...	...	D
broad.........	...	...	7 0	7 0	6 9	6 7	...	...	...	...	E
Framed with carlings...............*broad*.........	...	...	0 10	0 10	0 9½	0 9	...	...	...	...	F
deep..........	...	...	0 11	0 11	0 10½	0 10	...	...	...	...	G
Carlings asunder in the clear......................	...	...	5 9	5 9	5 9	5 9	...	...	...	...	H
Let down between the beams......................	...	...	0 1	0 1	0 1	0 1	...	...	...	...	I
Framing bolted with bolts,..........*in diameter*...	...	...	0 0⅞	0 0⅞	0 0⅞	0 0⅞	...	...	...	...	K
Partners bolted, two in each end, *in diameter*...	...	...	0 0⅞	0 0⅞	0 0⅞	0 0⅞	...	...	...	...	L
Iron hoop fitted in the partners.....*broad*.........	...	...	0 4	0 4	0 4	0 4	...	...	...	...	M
thick.........	...	...	0 0½	0 0½	0 0½	0 0½	...	...	...	...	N
RIDING BITTS...	...	...	...	...	...	...		See Gun Deck.			O
MAIN, JEER, and TOPSAIL SHEET BITTS, *square*, from the lower side of upper deck beam, to above the deck	1 2	1 1½	1 1	1 1	1 0	1 0	1 0	1 0	1 0	0 11	P
	2 9	2 9	2 8	2 8	2 8	2 8	2 8	2 8	2 8	2 7	Q
Heads above the deck or tenons into the quarter deck beams..................................	...	...	...	...	...	...	...	...	...	...	R
Heads tenon into the quarter deck beams, and score on the beams below......................	0 1¾	0 1¾	0 1½	0 1½	0 1½	0 1½	0 1¼	0 1¼	0 1¼	0 1¼	S
Heels to step on the lower or middle deck beam, and two bolts through each beam, *diameter*...	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	T
Cheek blocks on the outsides ......*thick*.........	0 4	0 4	0 3½	0 3½	0 3	0 3	0 3	0 3	0 3	0 3	U
Sheaves..............................*diameter*......	1 0	1 0	0 11	0 11	0 10	0 10	0 10	0 10	0 10	0 9½	X
Jeers and topsail sheets..............*thick*..........	0 3½	0 3½	0 3¼	0 3¼	0 3	0 2¾	0 2½	0 2½	0 2½	0 2⅜	Y
Clew-garnets, &c...................*thick*..........	0 1⅞	0 1¾	0 1¾	0 1¾	0 1⅝	0 1⅝	0 1½	0 1½	0 1½	0 1⅜	Z
The jeer and topsail sheet bitts should spread equally from the middle line, that their outsides may plumb with the centre											A
CROSS-PIECES to the jeer and topsail sheet bitts, to be *broad*.........	0 10½	0 10¼	0 10	0 10	0 9½	0 9½	0 9	0 9	0 8½	0 8	B
deep..........	0 9	0 9	0 8½	0 8½	0 8	0 8	0 7½	0 7½	0 7¼	0 6½	C
Upperside above the deck.........	2 0	2 0	1 10	1 10	1 10	1 10	1 10	1 10	1 10	1 10	D
Scored on, and faced upon the bitts	0 2	0 2	0 1½	0 1½	0 1½	0 1½	0 1½	0 1½	0 1½	0 1½	E
Ends without the bitts	2 2	2 2	2 0	2 0	1 10	1 10	1 7	1 7	1 5	1 5	F
Bolted at each end to the bitts, with two bolts, *diameter*......	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	G
GALLOWS CROSS-PIECE...............................*sided*...	0 11	0 10½	0 10	0 10	0 9½	0 9½	0 9	0 9	0 9	0 8½	H
(*** These are only used in the navy *deep*...	1 5	1 4	1 4	1 4	1 3	1 3	1 3	1 3	1 2¾	1 2	I
when the quarter deck is short of the *long*...	13 0	12 9	12 6	12 6	12 0	12 0	11 6	11 0	10 9	10 6	K
topsail sheet bitts.) *upperside above the deck*	7 0	7 0	7 0	7 0	6 10	6 9	6 9	6 8	6 8	6 6	L
Gallows Bitts and Cross Piece to be fitted in the fore hatchway, as those abaft in scantling and height for the booms to lie											M
CARLINGS.—Number of tiers on each side from the fore hatch to the mizen mast room..................	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	N
Thence forward and aft......*number of tiers*......	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	O
The carlings.................*broad*.................	0 10	0 9½	0 9	0 8	0 8	0 7½	0 8	0 7½	0 7½	0 7	P
deep..................	0 8	0 7	0 7	0 6	0 6	0 5½	0 6½	0 6½	0 6½	0 5½	Q
*** *Carlings in the hatchways, and for half beams, to be ¼ of an inch broader, and one inch deeper.*											
Half beams of fir abaft the mizen mast room........................ *broad*......	0 11	0 10	0 11	0 10	0 10	0 9	0 9	0 9	0 9	0 8	R
deep.......	0 8	0 7½	0 8	0 7½	0 7	0 7	0 6½	0 6½	0 6½	0 6	S
LEDGES...................................... *broad*......	0 5	0 4½	0 5	0 4½	0 4½	0 4½	0 4	0 4	0 4	0 4	T
deep.......	0 4½	0 4	0 4½	0 4	0 4	0 4	0 3½	0 3½	0 3½	0 3½	U
COAMINGS { To the hatchways, and to extend the whole length of ladderways, &c..... } *thick underside*....	0 11	0 11	0 11	0 11	0 10	0 10	0 6	0 6	0 6	0 5¾	X
thick upperside....	0 10	0 10	0 10	0 10	0 9	0 9	0 5	0 5	0 5	0 4¾	Y
stand above the deck	0 4	0 4	0 3½	0 3½	0 3½	0 3½	1 3	1 3	1 3	1 2	Z
Bolted, two bolts in a beam, *diameter*...........	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	A
Scored down between the beams.................	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	B

	Frigates. GUNS 28	Frigates. GUNS 24	Sloop of War. GUNS 18	*Denmark* Yacht. GUNS 10	Bomb-Vessel. GUNS 12	Brigantine. GUNS 10	Brig-Cutter. GUNS 24	Cutter. GUNS 16	East India Ships. TONS 1257	East India Ships. TONS 1000	East India Ships. TONS 818	West India Ships. TONS 544	West India Ships. TONS 440	West India Ships. TONS 330	Packet. TONS 201	Schooner. TONS 133	Brig. TONS 170	Sloop. TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	0 1	0 1	0 1	...	0 1	0 1	0 1	0 1	...	...	...	0 1	0 1	0 1	0 1	0 0⅞		
B	0 8	0 8	0 8	...	0 6	0 5	0 5	0 5	...	...	...	0 6	0 6	0 6				
C	1 11	1 11	1 10	...	1 2	1 0	1 0	1 0	...	...	...	1 4	1 3	1 3				
D	...	...	...	0 5	...	...	...	...	0 6	0 6	0 6							
E	...	...	...	5 6	...	...	...	...	6 7	6 7	6 7							
F	...	...	...	0 7	...	...	...	...	0 9	0 9	0 9							
G	...	...	...	0 8	...	...	...	...	0 10	0 10	0 10							
H	...	...	...	5 6	...	...	...	...	5 9	5 9	5 9							
I	...	...	...	0 0⅞	...	...	...	...	0 1	0 1	0 1							
K	...	...	...	0 0¾	...	...	...	...	0 0⅞	0 0⅞	0 0⅞							
L	...	...	...	0 0¾	...	...	...	...	0 0⅞	0 0⅞	0 0⅞							
M	...	...	...	0 3½	...	...	...	...	0 4	0 4	0 4							
N	...	...	...	0 0⅜	...	...	...	...	0 0½	0 0½	0 0½							
O	...	...	...	See Gun Deck.				...	...	...	...	...	...	See Gun Deck.				
P	0 11	0 10½	0 9	0 6½	0 8	0 7½	0 8½	0 8	0 11½	0 11	0 11	0 10½	0 10	0 9	0 8	0 7	0 7½	
Q	2 6	2 6	1 9															
R	...	...	...	3 0	5 0	3 0	3 3	3 1	3 8	3 6	3 6	3 3	3 2	3 1	3 0	2 10	3 0	
S	0 1¼	0 1¼	0 1¼	0 0¾	0 1⅛	0 1	0 1	0 1	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1	0 0⅞	0 1	
T	0 0⅞	0 0¾	0 0¾	0 0⅝	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	
U	0 3	0 2¾	0 2½	0 2	0 2½	0 2	0 2	0 2	0 3	0 3	0 3	0 3	0 3	0 2¾	0 2¼	0 2	0 2¼	
X	0 9½	0 8¾	0 7½	0 6	0 7½	0 7	0 7½	0 7	0 10	0 10	0 10	0 8¾	0 7¾	0 7½	0 7	0 6½	0 7	
Y	0 2⅜	0 2¼	0 1¾	0 1	0 1¾	0 1	0 1⅛	0 1⅛	0 2½	0 2½	0 2⅜	0 2¼	0 1¾	0 1½	0 1	0 1	0 1⅛	
Z	0 1⅜	0 1¼	0 1⅛	0 0¾	0 1	0 0⅞	0 1	0 1	0 1⅜	0 1½	0 1½	0 1¼	0 1⅛	0 1	0 0⅞	0 0⅞	0 0⅞	
A	of the pumps.																	
B	0 7½	0 7	0 6	0 5½	0 7	0 6	0 6½	0 6¼	0 9	0 9	0 8½	0 7½	0 7¼	0 7	0 6¾	0 6	0 6¼	
C	0 6	0 5½	0 4½	0 4	0 6	0 4	0 5	0 4¼	0 7	0 7	0 6¾	0 6	0 5¾	0 5½	0 4¾	0 4	0 4¼	
D	1 10	1 8	1 8	1 7	2 5	1 7	1 9	1 7	1 9	1 9	1 9	1 8	1 7	1 6	1 6	1 5	1 7	
E	0 1½	0 1½	0 1¼	0 1	0 1¼	0 1¼	0 1¼	0 1¼	0 1½	0 1½	0 1½	0 1⅜	0 1¼	0 1¼	0 1¼	0 1⅛	0 1¼	
F	1 4	1 4	1 4	1 2	1 3	1 3	1 4	1 3	1 7	1 7	1 7	1 6	1 4	1 4	1 3	1 2	1 3	
G	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	
H	0 8½	0 8	0 7	0 5¼	...	0 6	0 6½	0 6	...	...	...	0 8¾	0 7	0 6¾	0 6½	0 6	0 6½	
I	1 1	1 0	0 11	0 7½	...	0 9	0 10	0 9	...	...	...	1 0½	0 11	0 10½	0 10	0 9	0 9	
K	10 0	9 6	9 0	7 10	...	8 0	8 4	8 2	...	...	...	9 2	8 10	8 6	8 4	8 0	8 3	
L	6 5	6 4	6 3	5 4	...	5 0	5 0	5 0	...	...	...	5 8	5 6	5 4	5 3	5 0	5 2	
M	on, if required.																	
N	*three*	*three*	} *two*	*two*	*two*	*two*	*two*	*two*	...	...	...	...	...	*two*	*two*	*two*	*two*	*two*
O	*two*	*two*																
P	0 7	0 7	0 6½	0 5	0 7	0 5½	0 6	0 6	...	...	...	...	...	0 6½	0 6	0 6	0 6	0 5
Q	0 5½	0 5½	0 5	0 4½	0 6	0 4½	0 5	0 4½	...	...	...	...	...	0 5	0 4½	0 4½	0 5	0 4
R	0 8	0 7	0 7	...	...	...	...	...	0 7	0 6½	0 6	0 6						
S	0 6	0 5	0 5	...	...	...	...	...	0 5	0 4½	0 4	0 4						
T	0 4	0 4	0 3½	0 3	0 4½	0 3	0 3½	0 3	0 8	0 8	0 8	0 8	0 7	0 4	0 3½	0 3½	0 4	0 3
U	0 3	0 3	0 3	0 2½	0 3½	0 2¾	0 3	0 2¾	0 4	0 4	0 4	0 3½	0 3	0 3¼	0 3¼	0 3	0 3¼	0 2¾
X	0 5½	0 5½	0 5	0 4½	0 5	0 4½	0 4½	0 4½	0 7	0 7	0 7	0 6	0 6	0 6	0 5	0 4½	0 5	0 4
Y	0 4	0 4½	0 4	0 4	0 4	0 4	0 4	0 4	0 6	0 6	0 6	0 5	0 5	0 5	0 4	0 4	0 4	0 3½
Z	1 2	1 2	1 0	1 0	1 9	1 0	1 2	1 1	0 3	0 3	0 3	0 3	0 2½	0 2½	1 2	1 0	1 0	1 0
A	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅝
B	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
Upper Deck—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Head Ledges. { .... *thick...*	0 5½	0 5½	0 5½	0 5½	0 5	0 5	0 5	0 5	0 5	0 4¾	A
Head Ledges. { And round up more than the beam	0 1½	0 1½	0 1½	0 1½	0 1½	0 1½	0 1⅜	0 1⅜	0 1⅜	0 1¼	B
Gratings. { Ledges fir .... *broad...*	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	C
deep.....	0 3½	0 3½	0 3½	0 3½	0 3½	0 3½	0 3½	0 3½	0 3½	0 3½	D
Battens oak .... *broad ...*	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	E
thick....	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	F
Waterways—*(Or broader if clear of sap)..* { *.....thick....*	0 6	0 6	0 5	0 5	0 5	0 5	0 5	0 5	0 5	0 5	G
.... broad ...	0 11	0 11	0 11	0 11	0 11	0 11	0 11	0 11	0 11	0 11	H
bearded back	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0⅝	I
Flat of the Deck—Dantzick deal .... *thick ...*	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	K
Except English oak plank next waterways *number of strakes*	*five*	*five*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	L
Two oak binding strakes next the coaming......	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	M
Spirketting—On each side strakes .... *number...*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	N
Thick at the .... *lower edge*	0 4	0 4	0 5	0 5	0 4½	0 4½	0 4½	0 4½	0 4	0 4	O
upper edge	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	P
Bolts one through each butt, and two through each lower sill .... *diameter*	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	Q
Stuff between the ports or quickwork .... *thickness*	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	R
String in the Waist .... *number of strakes on each side*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	S
thick at the upper edge	0 5	0 5	0 5	0 5	0 4½	0 4	0 4	0 4	0 4	0 3½	T
Bearded from half its depth, to *thickness at lower edge*	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 3½	U
Scarphs between drifts and into the clamps *long*	4 9	4 9	4 6	4 6	4 6	4 6	4 6	4 0	4 0	4 0	X
Bolted through at every other timber at opposite edges .... *bolt's diameter*	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	Y
Gunwale, or Plank Sheer .... *thick*	0 5	0 5	0 4	0 4	0 4	0 4	0 4	0 3	0 3	0 3	Z
Bolts through the scarphs at every two feet six inches .... *diameter*	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	A
Plank sheers along the drifts .... *thick*	0 3	0 3	0 3	0 3	0 3	0 3	0 2½	0 2½	0 2½	0 2½	B
Broad enough to project for the mouldings and bolts through .... *diameter*	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅝	0 0⅝	0 0⅝	0 0⅝	C
Roughtrees. { To fit oak roughtrees along the midships .... { *broad*	...	...	...	...	...	...	...	...	...	...	D
deep	...	...	...	...	...	...	...	...	...	...	E
Collar Beam—Against the beakhead .... *square*	1 0	0 11½	0 11	0 11	0 10½	0 10					
The side ends to be knee'd with an iron knee *weight*	1 2 7	1 2 0	1 1 21	1 1 14	1 1 7	1 1 0					
Bolts in each .... *number*	*seven*	*seven*	*seven*	*seven*	*seven*	*six*					
diameter	0 1⅛	0 1⅛	0 1	0 1	0 1	0 0⅞					
*** *The upper side to be kept to the same height at the lower sills of the ports.*											
Beakhead Stantions—Those next } .... *square*	1 0	0 11½	0 11	0 11	0 10½	0 10					
the bowsprit .... { *asunder in the clear*	3 4	3 3	3 4	3 3	3 1	2 9					
And square above the collar beam	0 9	0 8½	0 8	0 7½	0 7	0 6½					
Other beakhead stantions .... *fore and aft*	0 9	0 8½	0 8	0 7½	0 7	0 6½					
Thwartships and rabbetted for 1½ inch deal.....	0 9½	0 9	0 8½	0 8	0 8	0 7½					
To face on to the cat beam	0 1½	0 1½	0 1½	0 1½	0 1¼	0 1¼					
And bolted each with two bolts .... *diameter*	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾					
*** *If half beams form the beak head, which is common of late years, (the collar beam being gotten with difficulty to cast over the bowsprit) the whole is united by a carling and an iron strap.*											
Beakhead Carling. { .... *broad*	1 4	1 3	1 3	1 3	1 2	1 2					
.... *deep*	1 6	1 5	1 4	1 4	1 3	1 3					
Iron Strap. { .... *broad*	0 5	0 4½	0 4½	0 4½	0 4½	0 4					
.... *thick*	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾					
Bolted about every 16 inches, bolts...... *diameter*	0 1	0 0⅞	0 0⅞	0 0⅞	0 0[illegible]	0 0¾					

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	0 4¾	0 4½	0 4	0 3¾	0 3¾	0 3½	0 3½	0 3½	0 5	0 5	0 4½	0 4½	0 4	0 3½	0 3	0 3	0 3	0 3
B	0 1¼	0 1¼	0 1¼	0 1⅛	0 1	0 1	0 1	0 1	0 1¼	0 1¼	0 1¼	0 1	0 1	0 1	0 1	0 1	0 1½	0 1
																	Hatches.	
C	0 3	0 3	0 2½	0 2	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	0 2	0 2½	0 2½
D	0 3½	0 3½	0 3	0 2½	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3
E	0 3	0 3	0 2½	0 2	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	0 2	1¼ deal.	
F	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅝		
G	0 5	0 4½	0 4	0 3½	0 4	0 3½	0 3½	0 3½	0 4	0 4	0 4	0 4	0 4	0 3½	0 3	0 3	0 3	0 3
H	0 10	0 10	0 10	0 9	0 10	0 10	0 10	0 10	0 11	0 11	0 11	0 11	0 10	0 10	0 9	0 9	0 9	0 9
I	0 0½	0 0½	0 0⅜	0 0⅜	0 0⅜	0 0⅜	0 0⅜	0 0⅜	0 0½	0 0½	0 0½	0 0½	0 0½	0 0⅜	0 0⅜	0 0⅜	0 0⅜	0 0¼
K	0 3	0 3	0 3	0 2½	0 2½	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 2½	0 2
L	*four*	*four*	*four*	*three*	*three*	*three*	*three*	*three*	*two*	*two*	*two*	*two*	*two*	*three*	*three*	*three*	*two*	*two*
M	0 4	0 4	0 4	0 3	0 3	0 4	0 4	0 4	...	...	...	...	...	{ *one* 0 4	0 3½	0 3½	0 3	0 3
N	*two*	*two*	*two*	*one*	*two*	*two*	*two*	*two*	*one*	*one*	*one*	*one*	*one*	*one*	*one*			
O	0 4	0 4	0 3	0 3	0 4	0 3	0 3	0 3	0 4	0 4	0 3	0 3	0 3	0 3	0 2½			
P	0 4	0 3½	0 3	0 2	0 3½	0 3	0 3	0 3	0 4	0 4	0 3	0 3	0 3	0 3	0 2½			
Q	0 0⅞	0 0¾	0 0¾	0 0⅝	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾			
R	0 3	0 2½	0 2	0 2	0 3	0 2	0 2	0 2	0 3	0 3	0 2½	0 2	0 2	0 2	0 2			
S	*two*	*two*	*two*	*one*	*one*	*one*	*one*	*one*	...	...	...	...	...	...	...	*one*		
T	0 3½	0 3½	0 3	0 2¾	0 3	0 3	0 3	0 3	...	...	...	...	...	...	...	0 3		
U	0 3½	0 3½	0 3	0 2¾	0 3	0 3	0 3	0 3	...	...	...	...	...	...	...	0 3		
X	3 9	3 9	3 6	3 6	3 9	3 6	3 6	3 6	...	...	...	...	...	...	...	3 0		
Y	0 0¾	0 0¾	0 0¾	0 0⅝	0 0⅞	0 0¾	0 0¾	0 0¾	...	...	...	...	...	...	...	0 0⅝		
Z	0 3	0 3	0 3	0 2½	0 6	0 3	0 3	0 3	0 5	0 5	0 5	0 4½	0 4½	0 4	0 3½	0 3	0 3	0 2½
A	0 0¾	0 0¾	0 0¾	0 0⅝	0 1	0 0¾	0 0¾	0 0¾	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅝
B	0 2½	0 2½	0 2	0 1¾	0 2½	...	...	...	0 4	0 4	0 3	0 3	0 3	0 2½	0 2	0 2		
C	0 0⅝	0 0⅝	0 0½	0 0⅝	0 0⅝	...	...	...	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅝	0 0⅝	0 0⅝		
D	...	...	...	...	...	...	...	...	0 9	0 9	0 8½	0 8	0 7½	0 6	...	0 6	0 4	
E	...	...	...	...	...	...	...	...	0 5	0 5	0 5	0 4½	0 4½	0 4	...	0 4	0 3	

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
UPPER DECK—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
SEAT TRANSOM.—*Broad or deep*	0 9	0 9	0 9	0 9	0 8	0 8	0 8	0 8	0 8	0 7	A
thick	0 7	0 7	0 7	0 7	0 6	0 6	0 6	0 6	0 6	0 5	B
Scored aft upon the counter timbers, and bolted through each *diameter*	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	C
Knee'd at each end with an iron knee, *weight*	1 3 0	1 3 0	1 2 21	1 2 14	1 2 7	1 2 0	1 1 21	1 1 14	1 1 7	1 1 0	D
Fore and aft arm take three bolts afore gallery door. Thwartship arm, *long*	4 6	4 6	4 0	4 0	4 0	4 0	3 9	3 9	3 9	3 9	E
Bolts, *diameter*	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	F
**** The upperside is kept to the same height as the lower sills of the ports.*											
STANDARDS.—Number on each side	*six*	*six*	*six*	*five*	*five*	*five*	*four*	*four*	*four*	*four*	G
If wood, *sided*	1 0	1 0	1 0	1 0	0 11	0 10	0 10	0 9	0 9	0 8½	H
Iron each, weight *cwt.*	2 3 0	2 2 14	2 2 0	2 2 0	2 1 0	2 0 14	2 0 7	2 0 0	1 3 14	1 3 7	I
Side arm, *long*	5 9	5 9	5 9	5 9	5 7	5 7	5 6	5 6	5 6	5 4	K
Thwartship arm *long*	4 0	4 0	3 10	3 10	3 9	3 7	3 6	3 6	3 6	3 6	L
Bolts in each *number*	*nine*	*nine*	*nine*	*nine*	*nine*	*eight*	*eight*	*eight*	*eight*	*eight*	M
diameter	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	N
BREASTHOOK under the bowsprit *sided*	...	...	...	...	...	...	0 11	0 10½	0 10	0 9¾	O
To be placed as high as can be under the bowsprit without cutting it. *long*	...	...	...	...	...	...	16 0	15 6	15 0	14 6	P
Bolts, *number*	...	...	...	...	...	...	13	13	13	13	Q
diameter	...	...	...	...	...	...	0 1¼	0 1¼	0 1⅛	0 1⅛	R
**** And another breasthook over the bowsprit, of the same dimensions, if room will admit.*											
IRON WORK TO PORTS, &c.											
To have two ring and two eye-bolts to each port, *diameter*	0 1¼	0 1¼	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	S
rings in the clear	0 5	0 5	0 5	0 4¾	0 4¾	0 4½	0 4½	0 4¼	0 4¼	0 4¼	T
eyes in the clear	0 2¼	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	U
Training eye bolts, one between each port, *diameter*	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	X
eye in the clear	0 2¼	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	Y
Ring bolts in the deck abreast each port, *diameter*	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	Z
rings in the clear	0 3½	0 3¼	0 3¼	0 3¼	0 3¼	0 3¼	0 3¼	0 3¼	0 3¼	0 3¼	A
Stopper bolts *diameter*	One in each beam before the main hatchway						0 1⅝	0 1⅝	0 1½	0 1½	B
(See Gundeck) *rings in the clear*							0 6	0 6	0 5½	0 5½	C
Toptackle eye bolts, two to the main and two to the foremast *diameter*	0 1¾	0 1¾	0 1⅝	0 1⅝	0 1⅝	0 1⅝	0 1⅝	0 1⅝	0 1⅝	0 1½	D
eyes in the clear	0 4½	0 4½	0 4	0 4	0 4	0 4	0 3¾	0 3¾	0 3¾	0 3¾	E
Triangular ring bolts for lashing booms and anchors *diameter*	0 1⅝	0 1⅝	0 1½	0 1½	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1¼	F
rings in the clear	0 10	0 10	0 9	0 9	0 9	0 9	0 9	0 9	0 9	0 7	G
Eye bolts in front of quarter deck and forecastle beams *diameter*	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1	H
eyes in the clear	0 3	0 3	0 2¾	0 2¾	0 2¾	0 2¾	0 2¾	0 2¾	0 2¾	0 2⅝	I
On each side *number*	*four*	*four*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	K
Eye bolts round the main and fore mast, *number to each*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	L
In the spirketting abreast of each mast	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	M
diameter	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 1	N
Round the mizen mast, *number*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	O
In the spirketting abreast the mast	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	P
diameter	0 1⅛	0 1⅛	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	Q
CRANKS — For capstan bars *diameter*	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	R
CRANKS — Bolts for ditto *diameter*	0 1	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	S
CRANKS — For the gunner *diameter*	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	T
PILLARS.—*Square* — Lower end	0 7	0 6½	0 6½	0 6½	0 6¼	0 6¼	0 6½	0 6¼	0 6¼	0 6	U
PILLARS.—*Square* — Upper end	0 6	0 5½	0 5½	0 5½	0 5¼	0 5¼	0 5½	0 5¼	0 5¼	0 5	X
PILLARS.—*Square* — Iron pillars near capstan and galley, *square*	0 2¼	0 2⅛	0 2	0 2	0 2	0 2	0 2	0 1¾	0 1¾	0 1¾	Y
GALLEY. — Doors abaft the Galley Broad, *each*	...	...	3 9	3 9	3 7	3 6					
GALLEY. — Cants *asunder in the clear*	...	...	8 6	8 6	8 0	7 9					
GALLEY. — *deep*	...	...	0 6	0 6	0 6	0 6					

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in*
A	0 7	0 7	0 6	0 5	...	0 5	0 5	0 5	0 8	0 8	0 7	0 7	0 6½	0 6				
B	0 5	0 5	0 4	0 3	...	0 4	0 4	0 4	0 6	0 6	0 5	0 5	0 4½	0 4				
C	0 0⅞	0 0⅞	0 0⅞	0 0¾	...	0 0¾	0 0¾	0 0¾	0 1⅛	0 1	0 1	0 1	0 0⅞	0 0⅞				
D	1 0 21	1 0 14	1 0 7	0 3 21	...	0 3 7	0 3 21	0 3 7	1 3 0	1 2 14	1 2 0	1 1 14	1 1 0	1 0 14				
E	3 9	3 9	3 6	3 6	...	3 3	3 6	3 3	4 0	3 10	3 9	3 9	3 9	3 6				
F	0 0⅞	0 0⅞	0 0⅞	0 0¾	...	0 0¾	0 0¾	0 0¾	0 1⅛	0 1	0 1	0 1	0 0⅞	0 0⅞				
G	*four*	*four*	*three*	...	*five*	...	...	...	*six*	*six*	*six*	*five*	*four*	*three*				
H	0 8	0 7½	0 7	...	0 7													
I	1 3 0	1 2 21	1 2 14	...	1 2 7	...	...	...	1 3 21	1 3 14	1 3 0	1 2 21	1 2 14	1 2 0				
K	5 4	5 4	5 0	...	4 9	...	...	...	5 6	5 6	5 0	5 0	4 9	4 9				
L	3 6	3 6	3 4	...	3 3	...	...	...	3 9	3 9	3 6	3 6	3 4	3 4				
M	*eight*	*eight*	*seven*	...	*six*	...	...	...	*seven*	*seven*	*seven*	*seven*	*seven*	*seven*				
N	0 1	0 1	0 0⅞	...	0 0⅞	...	...	...	0 1⅛	0 1⅛	0 1	0 1	0 0⅞	0 0⅞				
O	0 9½	0 8¾	0 8½	...	0 9	0 8½	0 9	0 8½	0 10½	0 10½	0 10	0 10	0 9½	0 9	0 8½	0 8	0 9	
P	14 0	13 6	13 0	...	10 0	10 0	11 0	10 6	16 0	15 6	15 0	15 0	14 0	12 6	11 6	11 0	11 6	
Q	13	13	11	...	*nine*	*nine*	*nine*	*nine*	13	13	13	13	11	*nine*	*nine*	*nine*	*nine*	
R	0 1⅛	0 1⅛	...	...	0 1⅛	0 1	0 1	0 1	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 1	0 1	0 0⅞	0 1	
S	0 1¼	0 1⅛	0 1	0 0⅞	0 1	0 1	0 1	0 1	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 0⅞		
T	0 4¼	0 4⅛	0 4	0 3½	0 4	0 3½	0 3½	0 3½	0 3¾	0 3¾	0 3½	0 3½	0 3¼	0 3¼	0 3	0 2¾		
U	0 2	0 2	0 1¾	0 1⅝	0 1¾	0 1¾	0 1¾	0 1¾	0 2	0 2	0 2	0 2	0 1¾	0 1¾	0 1¾	0 1¾		
X	0 1¼	0 1⅛	0 1	0 0⅞	0 1	0 1	0 1	0 1	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 0¾		
Y	0 2	0 2	0 1¾	0 1⅝	0 1¾	0 1¾	0 1¾	0 1¾	0 2	0 2	0 2	0 2	0 1¾	0 1¾	0 1¾	0 1¾		
Z	0 1	0 0⅞	0 0⅞	0 0¾	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞									
A	0 3	0 3	0 3	0 2¾	0 3	0 3	0 3	0 3	0 3									
B	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	...	...	...	0 1⅜	0 1⅜	0 1¼	0 1⅛	0 1	0 1⅛	0 1
C	0 5¼	0 5¼	0 5	0 5	0 5	0 5	0 5	0 5	...	...	...	0 5	0 5	0 4¾	0 4½	0 4	0 4¼	0 3½
D	0 1½	0 1½	0 1⅜	0 1¼	0 1⅜	0 1¼	0 1¼	0 1¼	0 1⅝	0 1⅝	0 1⅝	0 1½	0 1⅜	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛
E	0 3½	0 3½	0 3¼	0 3	0 3¼	0 3¼	0 3	0 3¼	0 4	0 4	0 4	0 3¾	0 3½	0 3¼	0 3	0 3	0 2¾	0 2½
F	0 1¼	0 1¼	0 1⅛	0 1	0 1⅛	0 1	0 1	0 1	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 1	0 0⅞	0 0⅞	
G	0 7	0 7	0 6	0 5	0 6	0 5½	0 5	0 5	0 8	0 8	0 8	0 7	0 7	0 6	0 5	0 5	0 4½	
H	0 1	0 1	0 0⅞	0 0¾	0 0⅞													
I	0 2⅝	0 2⅝	0 2½	0 2¼	0 2½													
K	*three*	*two*	*two*	*two*	*two*													
L	*eight*	*eight*	*eight*	*six*	*eight*	*seven*	*seven*	*seven*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*seven*	*six*	*six*
M	*six*	*six*	*six*	*six*	*six*	*four*	*four*	*four*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*four*	*three*	*three*
N	0 1	0 1	0 0⅞	0 0¾	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅛	0 1⅛	0 1⅛	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾
O	*six*	*six*	*five*	*five*	*five*	...	...	...	*six*	*six*	*six*	*six*	*six*	*five*	*five*			
P	*four*	*four*	*three*	*three*	*three*	...	...	...	*four*	*four*	*four*	*four*	*three*	*three*	*three*			
Q	0 0⅞	0 0⅞	0 0¾	0 0⅝	0 0¾	...	...	...	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 0¾			
R	0 1⅛	0 1⅛	0 1	0 0⅞	0 1													
S	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾													
T	0 0	0 0¾	0 0¾	...	0 0¾													
U	0 5¾	0 5½	0 5	0 4	0 5	...	...	...	0 5½	0 5½	0 5	0 5	0 4¾	0 4½				
X	0 4¾	0 4½	0 4¼	0 3	0 4¼	...	...	...	0 4½	0 4½	0 4¼	0 4¼	0 4¼	0 4				
Y	0 1⅝	0 1⅝	0 1⅝	...	0 1⅝													

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
UPPER DECK—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
WARD-ROOM, &c. BULKHEAD...... Munions or stiles................*broad*	0 10	0 10	0 10	0 10	0 10	0 10	0 10	0 10	0 10	0 10	A
....*thick*	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	B
Panels in breadth not to exceed	2 8	2 8	2 8	2 8	2 8	2 8	2 8	2 8	2 8	2 8	C
Stand upon cants..............................*broad*	0 7	0 7	0 6½	0 6½	0 6½	0 6½	0 6½	0 6½	0 6½	0 6½	D
deep	0 3½	0 3½	0 3½	0 3½	0 3½	0 3½	0 3	0 3	0 3	0 3	E
TILLER—To have a tiller of the size of the lower tiller and two-thirds of the length.											
SCUPPERS—On each side..............................*number*	*eight*	*eight*	*eight*	*seven*	*seven*	*seven*	*seven*	*seven*	*seven*	*seven*	F
diameter in the clear	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	G
Scupper abreast the pump and in the manger, *diameter in the clear*	...	...	...	...	...	...	0 5	0 5	0 5	0 5	H
MANGER..	...	...	...	...	...	...	See	Gun Deck.			
SHOT RACKS..........(See Gun Deck)................*broad*	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	I
deep	0 3½	0 3½	0 3½	0 3½	0 3½	0 3½	0 3½	0 3½	0 3½	0 3½	K
PORTS—each port to be fitted with half ports made of...... deal............*thick*	0 1½	0 1½	0 1½	0 1½	0 1½	0 1½	0 1½	0 1½	0 1½	0 1½	L
lined with ditto	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	M
Holes for the guns ....*diameter*											
Holes, lower part above the sills..................	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 3½	N
Flap, on upper part to hang with hinges....*deep*	0 7	0 7	0 7	0 7	0 7	0 7	0 7	0 7	0 7	0 7	O
DEAD-LIGHTS, to stern and quarter-lights; DEAD-DOORS to gallery doors, made of 1¼inch rabbetted deal lined with slit deal, and fitted with neck bolts.											
BLOCKS—For main tack..............................*deep*	0 10	0 10	0 10	0 10	0 10	0 10	0 9	0 9	0 9	0 9	P
diameter of the sheave	1 1	1 1	1 1	1 1	1 0	1 0	0 11	0 11	0 11	0 10	Q
thickness of the sheave	0 3¾	0 3¾	0 3½	0 3½	0 3⅜	0 3⅛	0 2¾	0 2½	0 2½	0 2¼	R
diameter of the pin....	0 1⅞	0 1⅞	0 1⅞	0 1⅞	0 1¾	0 1⅝	0 1½	0 1½	0 1½	0 1⅜	S
Bolted with two bolts in each lap........*diameter*	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	T
Block for fore and spritsail sheets........*deep.....*	1 1	1 1	1 0	1 0	1 0	1 0	1 0	1 0	1 0	0 11	U
Fore sheet ....*diameter of the sheave*	1 1	1 1	1 1	1 1	1 0	1 0	0 11	0 11	0 11	0 10	X
................*thickness of the sheave*	0 3¼	0 3⅛	0 3	0 3	0 2¾	0 2½	0 2⅜	0 2⅜	0 2	0 2	Y
................*diameter of the pin.....*	0 1¾	0 1¾	0 1¾	0 1¾	0 1⅝	0 1½	0 1⅜	0 1⅜	0 1⅜	0 1¼	Z
Spritsail sheets ....*diameter of the sheave*	1 1	1 1	1 1	1 1	1 0	1 0	0 11	0 11	0 11	0 10	A
.........*thickness of the sheave*	0 2⅛	0 2	0 1¾	0 1¾	0 1½	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	B
Bolted with two bolts in each lap........*diameter*	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	C
Block for main sheet and studding sail tack, *deep*	1 1	1 1	1 1	1 1	1 0	1 0	0 11	0 11	0 11	0 11	D
diameter of the sheave	1 1	1 1	1 1	1 1	1 0	1 0	0 11	0 11	0 11	0 10¼	E
thickness of the sheave	0 3¼	0 3⅛	0 3	0 3	0 2¾	0 2¾	0 2½	0 2½	0 2½	0 2¼	F
Studding sail tacks..........*thickness of the sheave*	0 1¾	0 1¾	0 1¾	0 1¾	0 1½	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	G
diameter of the pin											
ROLLERS—Oak, put up between decks to lead the messenger to the capstan clear of the pumps, &c.......... ....*diameter*	0 9	0 9	0 8	0 8	0 8	0 7	0 7	0 7	0 7	0 7	H
RANGE CLEATS—To be of oak..........................*thick*	0 6	0 5½	0 5	0 5	0 4½	0 4½	0 4	0 4	0 4	0 4	I
long.	3 9	3 9	3 6	3 6	3 4	3 2	3 0	3 0	3 0	3 0	K
If belaying bolts through the riders are preferred *diameter*	0 1¾	0 1¾	0 1⅝	0 1⅝	0 1⅝	0 1½	0 1½	0 1½	0 1½	0 1⅜	L
Range cleats bolted through the side with two bolts...*diameter*	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	M
CLAMPS for BOATSKIDS or BEAMS, of oak..............*thick*	0 4	0 4	0 4	0 4	0 4	0 4	0 3	0 3	0 3	0 3	N
broad	0 11	0 11	0 11	0 11	0 11	0 11	0 10	0 10	0 10	0 10	O
Bearded from half the breadth at lower edge to..	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	0 2	0 2	0 2	0 2	P
Nailed and bolted through the string, with bolts *diameter*	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅝	0 0⅝	0 0⅝	0 0⅝	Q
BEAMS or BOATSKIDS; of fir....................*sided...*	0 11	0 11	0 10	0 10	0 10	0 9	0 9	0 9	0 9	0 9	R
moulded	0 10	0 10	0 9	0 9	0 9	0 8	0 8	0 8	0 8	0 8	S
number	*six*	*six*	*six*	*six*	*six*	*five*	*five*	*five*	*five*	*five*	T
Bolted at each end, with one bolt.... *in diameter*	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	U
Bolts in the scarphs......................*number...*	*eight*	*eight*	*eight*	*eight*	*six*	*six*	*six*	*six*	*six*	*six*	X
diameter...	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	Y

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
A	0 9	0 9	0 9															
B	0 3	0 3	0 3															
C	2 8	2 8	2 8															
D	0 6	0 6	0 6															
E	0 3	0 3	0 3															
F	*seven*	*seven*	*seven*	*three*	*five*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*three*	*three*
G	0 4	0 4	0 4	0 3	0 4	0 3	0 3	0 3	*3in.by5*	*3in.by5*	*3in.by5*	*3in.by5*	*3in.by5*	0 3	0 3	0 2½	0 2	0 2
H	0 5	0 5	0 5	0 4	0 5	0 4	0 4	0 4	*4in.by6*	*4in.by6*	*4in.by6*	*4in.by6*	*4in.by6*	0 4	0 4	0 3	0 3	0 3
									Mostly made of cast iron with square sides.									
I	0 3½	0 3½	0 3	...	0 3	0 3	0 3¼	0 3										
K	0 3	0 3	0 2½	...	0 2½	0 2½	0 3	0 2½										
L	0 1½	0 1½	0 1½	0 1¼	0 1½	0 1½	0 1½	0 1½										
M	0 0¾	0 0¾	0 0¾	0 0½	0 0¾	0 0¾	0 0¾	0 0¾										
N	0 3½	0 3½	0 3½	...	0 3	0 3	0 3	0 3										
O	0 7	0 7	0 6	...	0 6													
P	0 9	0 8	0 8															
Q	0 10	0 9½	0 9															
R	0 2⅛	0 2	0 1¾															
S	0 1¼	0 1¼	0 1⅛															
T	0 0¾	0 0¾	0 0¾															
U	0 11	0 10	0 9															
X	0 10	0 9½	0 9															
Y	0 1¾	0 1⅝	0 1½															
Z	0 1⅛	0 1⅛	0 1															
A	0 10	0 9½	0 9															
B	0 1⅛	0 1	0 0⅞															
C	0 0¾	0 0¾	0 0¾															
D	0 11	0 10	0 9															
E	0 10	0 9½	0 9															
F	0 1¾	0 1⅝	0 1½															
G	0 1⅛	0 1	0 0⅞															
H	0 6½	0 6½	0 6															
I	0 3½	0 3½	0 3															
K	2 10	2 10	2 9															
L	0 1⅜	0 1⅜	0 1¼															
M	0 0¾	0 0¾	0 0⅝															
N	0 3	0 3	0 3															
O	0 10	0 9	0 9															
P	0 2	0 2	0 2															
Q	0 0⅝	0 0⅝	0 0⅝															
R	0 8	0 8	0 8															
S	0 7	0 7	0 6½															
T	*five*	*four*	*four*															
U	0 0¾	0 0¾	0 0¾															
X	*six*	*six*	*six*															
Y	0 0¾	0 0[illegible]	0 0[illegible]															

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
KNEES, IRON.—Each to weigh about……*cwt.*	2 1 0	2 1 0	2 0 14	2 0 14	2 0 7	2 0 7	2 0 0	2 0 0	2 0 0	1 3 14	A
Arms, *long*……	3 6	3 6	3 6	3 6	3 4	3 4	3 3	3 3	3 3	3 3	B
Bolts, *in number*……	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	C
diameter……	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	D
GANGBOARDS.—Prussian deal……*thick*……	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	E
broad……	4 6	4 4	4 3	4 3	4 2	4 0	3 9	3 9	3 6	3 4	F
Bolted through at every four feet distance, *diameter*……	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	G
Bolted down to the beams……*diameter*……	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 1	0 1	H
CAPSTANS.											
Centre of main jear capstan, abaft the centre of the main mast……	27 0	26 0	25 2	23 9	22 0	21 3	22 0	21 0	21 0	19 9	I
Centre of fore jear capstan, abaft centre of fore mast……	50 0	49 3	48 6	47 0	43 0	39 6	…	…	…	…	K
Barrel……*diameter*……	2 6¾	2 5¾	2 4¾	2 4¼	2 3¼	2 2½	2 0¾	1 11¾	1 10¾	1 9½	L
long……	11 0	11 0	10 11	10 11	10 10	10 10	10 9	10 9	10 9	10 8	M
If it works on an iron spindle, *its diameter*……	…	…	…	…	…	…	…	…	…	…	N
UPPER WHELPS……*number*……	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	O
length……	3 0	3 0	3 0	3 0	3 0	3 0	3 1	3 1	3 1	3 1	P
Inside edge……*thick*……	0 7½	0 7½	0 7	0 7	0 6½	0 6¼	0 6	0 6	0 6	0 5¾	Q
Tapering of the Whelps. Outside at the heel, *thick*……	0 11¼	0 11	0 10¾	0 10½	0 9½	0 8¾	0 8½	0 8½	0 8½	0 8⅜	R
Outside at the head, *thick*……	0 10¼	0 10	0 9¾	0 9½	0 8½	0 7¾	0 7½	0 7½	0 7½	0 7⅜	S
Broad at the heel……	1 3½	1 3½	1 3¼	1 3	1 1	0 11¾	0 11½	0 11½	0 11½	0 10¾	T
Broad at the head……	1 0	1 0	0 11¾	0 11½	0 9¾	0 8	0 7¾	0 7¾	0 7¾	0 7⅝	U
Height of the surge……	2 2	2 2	2 2	2 2	2 1	2 1	2 0	2 0	2 0	2 0	X
Two bolts through each whelp, *in diameter*……	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	Y
Upper Chocks. Underside above the surge……	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	Z
thick……	0 3⅛	0 3	0 2¾	0 2¾	0 2⅝	0 2⅝	0 2½	0 2½	0 2⅜	0 2⅜	A
Bolt in each chock, *diameter*……	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	B
Lower Chock. Underside above the heels of the whelps……	0 4½	0 4½	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	C
thick……	0 4½	0 4¼	0 4	0 4	0 4	0 3⅞	0 3¾	0 3¾	0 3¾	0 3⅝	D
Bolt in each chock, *diameter*……	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	E
Chock close up under the lower chock, *thick*……	0 3½	0 3½	0 3¼	0 3¼	0 3¼	0 3¼	0 3¼	0 3¼	0 3¼	0 3¼	F
LOWER WHELPS……*number*……	*five or*	*six*	*five or*	*six*	*five or*	*six*	*five or*	*six*	*five or*	*six*	G
length……	2 9	2 9	2 9	2 9	2 9	2 9	2 9	2 9	2 9	2 9	H
Inner edge……*thick*……	0 8¼	0 8¼	0 8	0 8	0 7½	0 7½	0 7	0 7	0 7	0 6¾	I
Tapering of the Whelps. *Outer edge at the heel, thick*……	1 1½	1 1½	1 1	1 1	1 0	0 11	0 10	0 10	0 10	0 9½	K
Outer edge at the head, thick……	1 0½	1 0½	1 0	1 0	0 11	0 10	0 9	0 9	0 9	0 8½	L
Broad at the heel……	0 11	0 11	0 10¾	0 10¾	0 10⅝	0 10⅝	0 10½	0 10½	0 10½	0 10	M
Broad at the head……	0 9½	0 9¼	0 9	0 9	0 8⅞	0 8⅞	0 8¾	0 8¾	0 8¾	0 8¼	N
Height of the surge……	2 0	2 0	1 11½	1 11½	1 11½	1 11	1 11	1 11	1 11	1 11	O
Two bolts through each whelp……*diameter*……	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	P
UPPER CHOCKS.—Underside above the surge……	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	Q
thick……	0 3¼	0 3⅛	0 3	0 3	0 2⅞	0 2⅞	0 2¾	0 2⅝	0 2⅝	0 2½	R
Bolt in each chock……*diameter*……	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	S
LOWER CHOCKS—Underside to fay on the pall head. *thick*……	0 5	0 4⅞	0 4¾	0 4¾	0 4½	0 4½	0 4¼	0 4¼	0 4¼	0 4	T
Bolt in each chock……*diameter*……	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 1	0 0⅞	U
DRUMHEAD……*diameter*……	5 6	5 4	5 3	5 2	4 11	4 9	4 6	4 4	4 2	4 0	X
Thickness of the upper piece……	0 8¼	0 8¼	0 8	0 8	0 7½	0 7	0 6	0 6	0 6	0 5¾	Y
Thickness of the lower piece……	0 7¼	0 7¼	0 7	0 7	0 6½	0 6¼	0 5½	0 5	0 5	0 5	Z
Bearded down from half the diameter To show in front……	1 2½	1 2½	1 2	1 2	1 1	1 0¼	0 10½	0 10	0 10	0 10	A
Tenon at head of the barrel……*square*……	1 6	1 6	1 6	1 6	1 4	1 4	1 2	1 2	1 2	1 1	B
Hoop for tenon……*broad*……	0 4¾	0 4¾	0 4½	0 4½	0 4½	0 4	0 4	0 4	0 4	0 4	C
thick……	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0½	0 0½	0 0½	0 0½	0 0½	D

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	1 3 7	1 2 21	1 2 14															
B	3 0	3 0	3 0															
C	*six*	*six*	*six*															
D	0 0¾	0 0¾	0 0¾															
E	0 3	0 3	0 2½															
F	3 4	3 2	3 0															
G	0 0¾	0 0¾	0 0¾															
H	0 0⅞	0 0⅞	0 0¾															
I	19 0	19 0	17 0	*afore it* 10 3	8 0	...	...	...	28 0	27 0	25 6	14 4½						
K	...	...	...	...	...	...	...	...	33 9	32 0	29 7							
L	1 9	1 8	1 6	1 5	1 5	1 4	1 5	1 4	2 3	2 2	2 1	1 8			1 3	1 2		
M	10 8	10 7	10 6	10 0	3 4	3 3	3 4	3 3	Upper Barrel. 4 0	4 0	4 0	3 4	To have a small capstan fitted abaft the main mast, with iron spindle, similar to that in the bomb vessel.		3 4	3 3		
N	...	...	...	...	0 6	0 5	0 5¾	0 5	Lower Barrel. 6 0	6 0	6 0	0 7			0 5½	0 5		
O	*six*	*six*	*six*	*five*	*five*	*five*	*five*	*five*	*six*	*six*	*six*	*five*			*five*	*five*		
P	3 1	3 1	3 0	3 0	2 10	2 10	2 10	2 10	2 11	2 11	2 11	2 11			2 10	2 10		
Q	0 5¾	0 5½	0 5½	0 5	0 5¼	0 4½	0 4¾	0 4½	0 6	0 6	0 6	0 5			0 4¼	0 4		
R	0 8¼	0 7¾	0 7⅜	0 6¾	0 7	0 6	0 6⅝	0 6	0 8½	0 8½	0 8½	0 7			0 5¾	0 5		
S	0 7⅛	0 6½	0 6¼	0 5½	0 5¾	0 5	0 5⅝	0 5	0 7½	0 7½	0 7½	0 6			0 4¾	0 4¼		
T	0 10½	0 10	0 9¼	0 8½	0 9	0 7¾	0 8	0 7¾	0 11	0 11	0 11	0 10			0 7½	0 7½		
U	0 7⅜	0 6¾	0 6¼	0 5¾	0 6	0 4¼	0 4½	0 4¼	0 7	0 7	0 7	0 5¼			0 4	0 4		
X	2 0	2 0	2 0	2 0	2 0	1 10½	1 11	1 10½	2 0	2 0	2 0	1 11			1 11	1 10½		
Y	0 1	0 0⅞	0 0⅞	0 0¾	0 0⅞	0 0¾	0 0¾	0 0¾	0 1⅛	0 1⅛	0 1⅛	0 0¾			0 0¾	0 0¾		
Z	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 0⅞	0 1	0 0⅞	0 1¾	0 1¾	0 1½	0 1	...	...	0 0⅞	0 0¾		
A	0 2¼	0 2¼	0 2	0 1¾	0 1⅞	0 1⅝	0 1¾	0 1⅝	0 2½	0 2½	0 2⅜	0 1¾	...	...	0 1⅝	0 1½		
B	0 0¾	0 0¾	0 0¾	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0⅞	0 0⅞	0 0⅞	0 0¾	...	...	0 0⅝	0 0⅝		
C	0 3¾	0 3¾	0 3⅝	0 3½	0 3½	0 3½	0 3½	0 3½	0 4	0 4	0 4	0 3½	...	...	0 3½	0 3¼		
D	0 3½	0 3⅜	0 3⅛	0 2⅝	0 3	0 3	0 3¼	0 3	0 4	0 4	0 4	0 3½	...	...	0 3	0 2⅞		
E	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 1	0 0⅞	0 0⅞	0 0¾	...	...	0 0¾	0 0⅝		
F	0 3¼	0 3	0 3	0 2¾	0 2⅞	0 2¾	0 2¾	0 2¾	0 3½	0 3½	0 3¼	0 3	...	...	0 2⅝	0 2½		
G	*five or*	*six*	*five*	Observe, when there are six whelps, they are of the same size as the upper whelps........					*five*	*five*	*five*							
H	2 9	2 9	2 9						2 9	2 9	2 9							
I	0 6½	0 6¼	0 6						0 7	0 7	0 7							
K	0 9	0 8½	0 8	...	...	...	...	...	0 10	0 10	0 10							
L	0 8	0 7½	0 7	...	...	...	...	...	0 9	0 9	0 9							
M	0 9½	0 9	0 8½	...	...	...	...	...	0 10½	0 10½	0 10½							
N	0 7¾	0 7¼	0 6¾	...	...	...	...	...	0 8¾	0 8¾	0 8¾							
O	1 11	1 11	1 11	...	...	...	...	...	1 11	1 11	1 11							
P	0 1⅛	0 1⅛	0 1	...	...	...	...	...	0 1¼	0 1¼	0 1¼							
Q	0 1	0 1	0 1	...	...	...	...	...	0 1¼	0 1¼	0 1¼							
R	0 2⅜	0 2⅜	0 2⅛	...	...	...	...	...	0 2⅞	0 2⅞	0 2¾							
S	0 0¾	0 0¾	0 0¾	...	...	...	...	...	0 0⅞	0 0⅞	0 0⅞							
T	0 4	0 4	0 3¾	...	...	...	...	...	0 4½	0 4½	0 4¼							
U	0 0⅞	0 0⅞	0 0⅞	...	...	...	...	...	0 1	0 1	0 1							
X	3 10	3 8	3 4	3 2	3 2	2 10	3 0	2 10	4 1	4 1	4 1	3 4	...	...	2 10	2 9		
Y	0 5¾	0 5¾	0 5½	0 5¼	0 5	0 4	0 4¼	0 4	0 6	0 6	0 6	0 4½	...	...	0 4	0 3¾		
Z	0 5	0 5	0 4¾	0 4¼	0 4	0 4	0 4¼	0 4	0 5	0 5	0 5	0 4½	...	...	0 4	0 3¾		
A	0 10	0 10	0 9½	0 9	0 8¼	...	..	...	0 10	0 10	0 10							
B	1 1	0 11	0 11	0 10	0 10	0 9	0 9	0 9	1 4	1 3	1 2	0 10	...	...	0 9	0 8		
C	0 3¾	0 3¾	0 3½	0 3¼	0 3½	0 3	0 3¼	0 3	0 4	0 4	0 4	0 3½	...	...	0 3	0 3		
D	0 0½	0 0½	0 0½	0 0⅜	0 0⅜	0 0⅜	0 0⅜	0 0⅜	0 0½	0 0½	0 0½	0 0½	...	...	0 0⅜	0 0⅜		

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
CAPSTANS—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
To let up into the upper piece of drumhead.....	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 1½	A
Lower piece of drumhead face down upon the whelps........	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	B
Underside above the deck..........	3 3	3 3	3 3	3 3	3 3	3 3	3 3	3 3	3 3	3 4	C
DRUM-HEAD. Bar-holes..........*number*	*twelve*	*twelve*	*twelve*	*twelve*	*twelve*	*twelve*	*twelve*	*twelve*	*twelve*	*twelve*	D
square.	0 4¾	0 4¾	0 4¾	0 4½	0 4¼	0 4	0 4	0 4	0 3¾	0 3¾	E
depth..	1 5	1 5	1 4½	1 4	1 3	1 2	1 0	1 0	0 11½	0 11¼	F
Iron circular plates..........*broad..*	0 3¼	0 3¼	0 3¼	0 3¼	0 3¼	0 3¼	0 3	0 3	0 3	0 3	G
thick..	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0½	0 0½	0 0½	0 0½	H
Countersunk holes..........*number*	*twelve*	*twelve*	*twelve*	*twelve*	*twelve*	*twelve*	*twelve*	*twelve*	*twelve*	*twelve*	I
For bolts..........*diameter*	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 1	K
Bolted down through each upper chock *diameter*	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 1	0 0⅞	0 0⅞	L
BARS *number*	*twelve*	*twelve*	*twelve*	*twelve*	*twelve*	*twelve*	*twelve*	*twelve*	*twelve*	*twelve*	M
length.	13 0	13 0	13 0	12 6	12 0	12 0	12 0	11 6	11 6	11 0	N
square at drumhead	0 5	0 5	0 5	0 4¾	0 4½	0 4¼	0 4¼	0 4¼	0 4	0 4	O
square at outer end	0 3¾	0 3¾	0 3¾	0 3⅝	0 3⅜	0 3⅝	0 3⅝	0 3⅝	0 3	0 3	P
TRUNDLE HEAD— Diameter..........	5 2	5 0	4 11	4 10	4 7	4 5	4 2	4 0	3 9	3 8	Q
Thickness of the upper piece..........	0 7½	0 7¼	0 7	0 7	0 6¼	0 6	0 5¼	0 5	0 5	0 5	R
Thickness of the lower piece..........	0 7½	0 7¾	0 7	0 7	0 6¼	0 6	0 5¼	0 5	0 5	0 5	S
Bearded down from one inch without the barrel To show in front..........	1 2¼	1 2	1 1¼	1 1¼	1 0½	0 11¾	0 9¼	0 9¼	0 9¼	0 9¼	T
Lower piece to face down upon the whelps...	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	U
Underside above the deck..........	3 7	3 7	3 7	3 7	3 6	3 6	3 6	3 6	3 6	3 5	X
Bar-holes..........*in number*	*ten*	*ten*	*ten*	*ten*	*ten*	*ten*	*ten*	*ten*	*ten*	*ten*	Y
square...	0 4¾	0 4¾	0 4¾	0 4½	0 4¼	0 4	0 4	0 4	0 3¾	0 3¾	Z
depth....	1 4	1 4	1 3	1 2	1 2	1 1	0 11	0 11	0 10½	0 10	A
Iron circular plates, two in number.. *broad....*	0 3¼	0 3¼	0 3¼	0 3¼	0 3¼	0 3¼	0 3¼	0 3¼	0 3¼	0 3¼	B
thick....	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0½	0 0½	0 0½	0 0½	C
Countersunk holes..........*number*	*ten*	*ten*	*ten*	*ten*	*ten*	*ten*	*ten*	*ten*	*ten*	*ten*	D
For bolts..........*diameter*	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 1	E
Bolted through the barrel........*bolt's diameter*	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	F
PALL HEAD Diameter..........	5 1	5 1	5 1	5 1	4 9¼	4 9¼	4 9¼	4 6	4 6	4 6	G
Thick..........	0 7½	0 7½	0 7½	0 7½	0 7¼	0 7¼	0 6¾	0 6¾	0 6¾	0 6¾	H
Underside kept above the step..........	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	I
To face on upon the heels of the whelps..........	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	K
Iron circular plates..........*broad*	0 3½	0 3½	0 3¼	0 3¼	0 3¼	0 3¼	0 3¼	0 3	0 3	0 3	L
thick	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅝	0 0⅝	0 0⅝	M
Countersunk holes..........*number*	12	12	12	12	12	12	12	12	12	12	N
For bolts..........*in diameter*	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	O
Iron hoop broad, to receive the palls and slip bolts..........	0 5½	0 5½	0 5	0 5	0 5	0 5	0 5	0 5	...	...	P
thick......	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¼	0 0⅝	0 0⅝	...	...	Q
Countersunk holes..........*in number*	*eight*	*eight*	*six*	*six*	*six*	*six*	*six*	*six*	...	...	R
For bolts..........*diameter..*	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	...	...	S
Bolted; two in each through the lower chocks..........*bolt's diameter*	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	T
DROP PALLS. Long..........	2 9	2 9	2 9	2 7	2 7	2 4	2 4	2 2	2 0	2 0	U
Thick at the pall bolt..........	0 2¼	0 2¼	0 2	0 2	0 1¾	0 1¾	0 1¾	0 1⅝	0 1⅝	0 1⅝	X
Thick at outer end..........	0 2¾	0 2⅝	0 2½	0 2½	0 2½	0 2⅜	0 2⅜	0 2¼	0 2¼	0 2⅛	Y
Broad..........	0 3¼	0 2⅞	0 3	0 3	0 3	0 2⅞	0 2⅞	0 2¾	0 2¾	0 2⅝	Z
Pall bolt..........*long.....*	1 8	1 8	1 7	1 7	1 6	1 5	1 4	1 4	1 4	1 2	A
diameter	0 2¼	0 2⅛	0 2	0 2	0 2	0 1⅞	0 1⅞	0 1⅝	0 1⅝	0 1½	B
When no hoop .. Pall plates..........*long....*	1 0	1 0	0 11	0 11	0 10	0 10	0 9	0 9	0 8	0 8	C
broad...	0 6	0 6	0 5¾	0 5¾	0 5	0 5	0 5	0 5	0 4¾	0 4¾	D
thick...	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	E
Ketch or slip bolts..........*long....*	0 10	0 10	0 9½	0 9½	0 9½	0 9	0 8	0 8	0 7¼	0 7¼	F
diameter inner end	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1	0 1	G
diameter outer end	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	H

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigan-tine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	0 1½	0 1½	0 1½	0 1	0 1	0 1	0 1	0 1	0 2	0 2	0 2	0 1½	...	...	0 1	0 0¾		
B	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 1	0 1	0 1	0 0⅞	...	...	0 0¾	0 0⅝		
C	3 4	3 4	3 4	3 4	3 4	3 5	3 5	3 5	3 3	3 3	3 3	3 4	...	...	3 5	3 5		
D	*twelve*	*twelve*	*ten*	*eight*	*eight*	*six*	*six*	*six*	*twelve*	*twelve*	*twelve*	*eight*	...	...	*six*	*sx*		
E	0 3¾	0 3½	0 3½	0 3¼	0 3½	0 3¼	0 3¼	0 3¼	0 4	0 4	0 4	0 3½	...	...	0 3¼	0 3¼		
F	0 11	0 11	0 10½	0 9	0 9	0 9	0 9	0 9	0 11½	0 11	0 11	0 10	...	...	0 9	0 8		
G	0 3	0 3	0 3	0 2¾	0 2¾	0 2½	0 2½	0 2½	0 3	0 3	0 3	0 3	...	...	0 3	0 2¾		
H	0 0½	0 0½	0 0⅜	0 0⅜	0 0⅜	0 0¼	0 0¼	0 0¼	0 0½	0 0½	0 0½	0 0⅜	...	...	0 0⅜	0 0¼		
I	*twelve*	*twelve*	*ten*	*eight*	*eight*	*six*	*six*	*six*	*twelve*	*twelve*	*twelve*	*eight*	...	...	*six*	*six*		
K	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0⅝	0 0⅝	0 0⅝	0 1	0 1	0 1	0 0⅞	...	...	0 0⅝	0 0⅝		
L	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0⅝	0 0⅝	0 0⅝	0 0⅞	0 0⅞	0 0⅞	0 0¾	...	...	0 0⅝	0 0⅝		
M	*twelve*	*twelve*	*ten*	*eight*	*eight*	*six*	*six*	*six*	*twelve*	*twelve*	*twelve*	*eight*	...	...	*six*	*six*		
N	10 6	9 6	9 0	8 0	8 0	7 6	7 6	7 6	14 0	14 0	14 0	8 0	...	...	7 3	7 0		
O	0 4	0 3¾	0 3¾	0 3½	0 3¾	0 3½	0 3½	0 3½	0 4¼	0 4¼	0 4¼	0 3⅜	...	...	0 3½	0 3½		
P	0 3	0 2⅞	0 2⅝	0 2¾	0 2⅞	0 2¾	0 2¾	0 2¾	0 3¼	0 3¼	0 3¼	0 2¾	...	...	0 2½	0 2¼		
Q	3 6	3 4	3 0	...	...	...	...	...	4 0	4 0	4 0							
R	0 5	0 5	0 4½	...	...	...	...	...	0 6	0 6	0 6							
S	0 5	0 5	0 4½	...	...	...	...	...	0 5	0 5	0 5							
T	0 9¼	0 9¼	0 8⅜	...	...	...	...	...	0 10	0 10	0 10							
U	0 1	0 0⅞	0 0⅞	...	...	...	...	...	0 1	0 1	0 1							
X	3 5	3 5	3 4	...	...	...	...	...	3 6	3 6	3 6							
Y	*ten*	*ten*	*ten*	...	...	...	...	...	*ten*	*ten*	*ten*							
Z	0 3¾	0 3½	0 3½	...	...	...	...	...	0 4	0 4	0 4							
A	0 10	0 10	0 9	...	...	...	...	...	1 0	1 0	1 0							
B	0 3	0 3	0 3	...	...	...	...	...	0 3½	0 3½	0 3½							
C	0 0½	0 0½	0 0⅜	...	...	...	...	...	0 0½	0 0½	0 0½							
D	*ten*	*ten*	*ten*	...	...	...	...	...	*eight*	*eight*	*eight*							
E	0 0⅞	0 0⅞	0 0¾	...	...	...	...	...	0 1	0 1	0 1							
F	0 0⅞	0 0⅞	0 0¾	...	...	...	...	...	0 0⅞	0 0⅞	0 0⅞							
G	4 4	4 4	4 4	...	...	...	...	...	4 4¼	4 4¼	4 4¼							
H	0 6½	0 6½	0 6½	...	...	...	...	...	0 7	0 7	0 7							
I	0 0⅞	0 0⅞	0 0⅞	...	...	...	...	...	0 1	0 1	0 1							
K	0 1¼	0 1¼	0 1⅛	...	...	...	...	...	0 1¼	0 1¼	0 1¼							
L	0 3	0 3	0 3	...	...	...	...	...	0 3½	0 3½	0 3½							
M	0 0⅝	0 0½	0 0½	...	...	...	...	...	0 0⅝	0 0⅝	0 0⅝							
N	12	12	12	...	...	...	...	...	12	12	12							
O	0 0¾	0 0¾	0 0¾	...	...	...	...	...	0 1	0 1	0 1							
P	...	...	...	...	...	...	...	...	0 5	0 5	0 5							
Q	...	...	...	...	...	...	...	...	0 0⅝	0 0⅝	0 0⅝							
R	...	...	...	...	...	...	...	...	*four*	*four*	*four*							
S	...	...	...	...	...	...	...	...	0 0⅞	0 0⅞	0 0⅞							
T	0 0⅞	0 0⅞	0 0⅞	...	...	...	...	...	0 1	0 1	0 1							
U	1 10	1 9	1 7	...	...	...	...	...	1 10	1 10	1 10							
X	0 1½	0 1½	0 1¾	...	...	...	...	...	0 1⅝	0 1⅝	0 1⅝							
Y	0 2⅛	0 2	0 2	...	...	...	...	...	0 2¼	0 2¼	0 2¾							
Z	0 2⅝	0 2⅜	0 2¼	...	...	...	...	...	0 2¾	0 2¾	0 2¾							
A	1 2	1 0	1 0	...	...	...	...	...	1 1	1 1	1 1							
B	0 1½	0 1⅜	0 1¼	...	...	...	...	...	0 1⅝	0 1⅝	0 1⅝							
C	0 7	0 7	0 6	...	...	...	...	...	0 8	0 8	0 8							
D	0 4½	0 4½	0 4½	...	...	...	...	...	0 4¾	0 4¾	0 4¾							
E	0 0¾	0 0¾	0 0⅝	...	...	...	...	...	0 0⅞	0 0⅞	0 0⅞							
F	0 7	0 7	0 7	...	...	...	...	...	0 7¼	0 7¼	0 7¼							
G	0 1	0 1	0 1	...	...	...	...	...	0 1	0 1	0 1							
H	0 0¾	0 0¾	0 0¾	...	...	...	...	...	0 0¾	0 0¾	0 0¾							

PARTICULARS OF EACH DIMENSION, OR SCANTLING.		Of Three Decks.		Of Two Decks.				Frigates.				
		GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
CAPSTANS—*continued.*		*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
When no Hoop.	Slip bolt plates......*long*......	0 5	0 5	0 4¾	0 4¾	0 4¾	0 4¾	0 4¾	0 4½	0 4½	0 4½	A
	broad.....	0 2½	0 2½	0 2½	0 2½	0 2¼	0 2¼	0 2¼	0 2	0 2	0 2	B
	thick.....	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0⅜	0 0⅜	0 0⅜	C
CAST IRON PALL RIM.	Diameter to the outside......	5 9	5 9	5 9	5 9	5 5¼	5 5¼	5 5¼	5 1	5 1	5 1	D
	broad......	0 5	0 5	0 5	0 5	0 4½	0 4½	0 4½	0 4¼	0 4¼	0 4¼	E
	deep......	0 4¾	0 4¾	0 4¾	0 4¾	0 4½	0 4½	0 4½	0 4¼	0 4¼	0 4¼	F
	Bottom......*thick*......	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 1	0 1	G
	Number of holes counter-sunk......	12	12	12	12	12	12	12	12	12	12	H
	To bolt it down......*diameter*......	0 1½	0 1½	0 1½	0 1½	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	I
	Number of holes for nailing elm pieces......	24	24	24	24	24	24	24	24	24	24	K
	bolt's diameter	0 0⅜	0 0⅜	0 0⅜	0 0⅜	0 0⅜	0 0⅜	0 0⅜	0 0⅜	0 0⅜	0 0⅜	L
	To weigh about......*cwt*......	5 0 0	5 0 0	5 0 0	5 0 0	4 3 9	4 3 9	4 3 9	4 2 4	4 2 4	4 2 4	M
MIDDLE SPINDLE.	Long......	...	...	...	...	...	...	...	...	...	...	N
	Middle......*diameter*......	...	...	...	...	...	...	...	...	...	...	O
	Ends......*diameter*......	...	...	...	...	...	...	...	...	...	...	P
	Bolt-holes from each end, two, *one at*......	...	...	...	...	...	...	...	...	...	...	Q
	one at......	...	...	...	...	...	...	...	...	...	...	R
	diameter......	...	...	...	...	...	...	...	...	...	...	S
	Thickness of the neckings......	...	...	...	...	...	...	...	...	...	...	T
	Neckings......*asunder*......	...	...	...	...	...	...	...	...	...	...	U
	Neckings......*square*......	...	...	...	...	...	...	...	...	...	...	X
LOWER SPINDLE.	Long......	2 8	2 8	2 6	2 6	2 5	2 5	2 5	2 4	2 4	2 4	Y
	Diameter in the cup or step......	0 6½	0 6½	0 6	0 6	0 5¾	0 5¾	0 5¾	0 5½	0 5½	0 5½	Z
	Diameter at the upper end......	0 5¾	0 5¾	0 5½	0 5½	0 5	0 5	0 5	0 4¾	0 4¾	0 4¾	A
	Bolt-hole from the end......	0 3	0 3	0 2½	0 2½	0 3	0 3	0 3	0 3	0 3	0 3	B
	diameter......	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	C
	Thickness of the necking......	0 2	0 2	0 1⅞	0 1⅞	0 1⅞	0 1⅞	0 1⅞	0 1¾	0 1¾	0 1¾	D
	Ditto......*square*......	0 9	0 9	0 8½	0 8½	0 7	0 7	0 7	0 6¾	0 6¾	0 6¾	E
	Length of the spindle below the necking....	0 7½	0 7½	0 7	0 7	0 6	0 6	0 6	0 5	0 5	0 5	F
	Ditto in the cup or step......	0 6¼	0 6¼	0 6⅛	0 6	0 5½	0 5½	0 5½	0 4¾	0 4¾	0 4¾	G
	Lower spindle, weight about......*cwt*......	2 3 18	2 3 18	2 3 0	2 3 0	2 2 14	2 2 14	2 2 14	2 2 0	2 2 0	2 2 0	H
	Two iron cross plates over the necking of middle spindle, thick in the middle......	...	...	...	...	...	...	...	...	...	...	I
	And at the ends......	...	...	...	...	...	...	...	...	...	...	K
	Long......*or diameter*......	...	...	...	...	...	...	...	...	...	...	L
	Four bolts, one in each arm......*in diameter*......	...	...	...	...	...	...	...	...	...	...	M
	Two iron plates, each to weigh......*cwt*......	...	...	...	...	...	...	...	...	...	...	N
	Two dodecagon, or 12 sided, iron hoops, one over each cross...... *broad*......	...	...	...	...	...	...	...	...	...	...	O
	thick......	...	...	...	...	...	...	...	...	...	...	P
	Each to weigh......*cwt*......	...	...	...	...	...	...	...	...	...	...	Q
	Iron plate over the necking of lower spindle, *thick*	0 1¾	0 1¾	0 1½	0 1½	0 1⅜	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	R
	square.....	1 6	1 6	1 4	1 4	1 4	1 4	1 4	1 4	1 4	1 4	S
	Hoop over ditto......*thick*......	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	T
	broad......	0 5½	0 5½	0 5	0 5	0 5	0 5	0 5	0 5	0 5	0 5	U
	Cast-iron cup or stop, square on upperside......	0 11	0 11	0 10	0 10	0 10	0 10	0 10	0 9	0 9	0 9	X
	Lower side......	0 10	0 10	0 9	0 9	0 9	0 9	0 9	0 7	0 7	0 7	Y
	deep......	0 10	0 10	0 9	0 9	0 9	0 9	0 9	0 7	0 7	0 7	Z
YOKE.	—Square at the heels......	0 4½	0 4½	0 4	0 4	0 4	0 3¾	0 3¾	0 3¾	0 3¾	...	A
	Collar, to be oak plank......*thick*......	0 3	0 3	0 3	0 3	0 3	0 2¾	0 2¾	0 2¾	0 2¾	...	B
	Bolts to ditto......*diameter*...	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅝	0 0⅝	0 0⅝	0 0⅝	...	C
	Middle spindle, weight......*cwt*......	...	...	...	...	...	...	...	...	...	...	D
WINDLASS.												
	Length......	...	...	...	...	...	...	...	...	...	...	E
	Diameter in the middle......	...	...	...	...	...	...	...	...	...	...	F
	Diameter at the ends......	...	...	...	...	...	...	...	...	...	...	G
	Abaft the fore mast's centre......	...	...	...	...	...	...	...	...	...	...	H
	Underside above the deck, about......	...	...	...	...	...	...	...	...	...	...	I
	Iron spindles......*in number*......	...	...	...	...	...	...	...	...	...	...	K

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
A	0 4½	0 4¼	0 4¼	...	...	...	...	...	0 4½	0 4½	0 4½							
B	0 2	0 2	0 2	...	...	...	...	...	0 2	0 2	0 2							
C	0 0⅜	0 0⅜	0 0⅜	...	...	...	...	...	0 0⅜	0 0⅜	0 0⅜							
D	4 9	4 9	4 9	...	...	...	...	...	4 10½	4 10½	4 10½							
E	0 4	0 4	0 4	...	...	...	...	...	0 4	0 4	0 4							
F	0 3¾	0 3¾	0 3¾	...	...	...	...	...	0 3¾	0 3¾	0 3¾							
G	0 1	0 1	0 1	...	...	...	...	...	0 1¼	0 1¼	0 1¼							
H	12	12	12	...	...	...	...	...	12	12	12							
I	0 1⅛	0 1⅛	0 1⅛	...	...	...	...	...	0 1½	0 1½	0 1½							
K	24	24	24	...	...	...	...	...	24	24	24							
L	0 0¾	0 0⅜	0 0⅜	...	...	...	...	...	0 0⅜	0 0⅜	0 0⅜							
M	4 1 0	4 1 0	4 1 0	...	...	...	...	...	4 1 9	4 1 9	4 1 9							
N	...	...	...	...	...	...	...	...	5 4	5 4	5 4							
O	...	...	...	...	...	...	...	...	0 7½	0 7½	0 7½							
P	...	...	...	...	...	...	...	...	0 6¼	0 6¼	0 6¼							
Q	...	...	...	...	...	...	...	...	0 4	0 4	0 4							
R	...	...	...	...	...	...	...	...	0 8	0 8	0 8							
S	...	...	...	...	...	...	...	...	0 1¼	0 1¼	0 1¼							
T	...	...	...	...	...	...	...	...	0 4½	0 4½	0 4½							
U	...	...	...	...	...	...	...	...	0 9	0 9	0 9							
X	...	...	...	...	...	...	...	...	0 7½	0 7½	0 7½							
Y	2 3	2 3	2 3	...	...	...	...	...	2 6	2 6	2 6							
Z	0 5	0 5	0 5	...	...	...	...	...	0 5	0 5	0 5							
A	0 4¼	0 4¼	0 4¼	...	...	...	...	...	0 4¼	0 4¼	0 4¼							
B	0 2½	0 2½	0 2½	...	...	...	...	...	0 3	0 3	0 3							
C	0 0⅞	0 0⅞	0 0⅞	...	...	...	...	...	0 1	0 1	0 1							
D	0 1⅝	0 1⅝	0 1⅝	...	...	...	...	...	0 1¾	0 1¾	0 1¾							
E	0 6¾	0 6¾	0 6¾	...	...	...	...	...	0 6¾	0 6¾	0 6¾							
F	0 5	0 5	0 5	...	...	...	...	...	0 6	0 6	0 6							
G	0 4½	0 4½	0 4½	...	...	...	...	...	0 5	0 5	0 5							
H	2 0 14	2 0 14	2 0 14	...	...	...	...	...	2 1 21	2 1 21	2 1 21							
I	...	...	...	...	...	...	...	...	0 4	0 4	0 4							
K	...	...	...	...	...	...	...	...	0 2½	0 2½	0 2½							
L	...	...	...	...	...	...	...	...	2 6	2 6	2 6							
M	...	...	...	...	...	...	...	...	0 1	0 1	0 1							
N	...	...	...	...	...	...	...	...	1 0 1	1 0 1	1 0 1							
O	...	...	...	...	...	...	...	...	0 8	0 8	0 8							
P	...	...	...	...	...	...	...	...	0 1¾	0 1¾	0 1¾							
Q	...	...	...	...	...	...	...	...	1 2 0	1 2 0	1 2 0	...						
R	0 1¼	0 1¼	0 1¼	...	...	...	...	...	0 1¼	0 1¼	0 1¼							
S	1 4	1 4	1 4	...	...	...	...	...	1 5	1 5	1 5							
T	0 1¼	0 1¼	0 1¼	...	...	...	...	...	0 1¼	0 0¼	0 1¼							
U	0 5	0 5	0 5	...	...	...	...	...	0 5	0 5	0 5							
X	0 9	0 9	0 9	...	...	...	...	...	0 9	0 9	0 9							
Y	0 7	0 7	0 7	...	...	...	...	...	0 7	0 7	0 7							
Z	0 7	0 7	0 7	...	...	...	...	...	0 7	0 7	0 7	...						
A	...	...	...	...	...	...	...	...	0 4	0 4	0 3¾							
B	...	...	...	...	...	...	...	...	0 3	0 3	0 2¾	...						
C	...	...	...	...	...	...	...	...	0 0¾	0 0¾	0 0⅝	...						
D	...	...	...	...	...	...	...	...	5 0 9	5 0 9	5 0 9	...						
E	...	...	...	...	...	...	...	...	...	...	...	...	21 8	20 0	...	...	14 10	13 0
F	...	...	...	...	...	...	...	...	...	...	...	...	2 2	1 10	...	...	1 3½	1 2
G	...	...	...	...	...	...	...	...	...	...	...	...	1 8	1 6	...	...	0 11½	0 11
H	...	...	...	...	...	...	...	...	...	...	...	...	5 0	4 6	...	...	2 0	...
I	...	...	...	...	...	...	...	...	...	...	...	...	1 0	1 0	...	...	0 11	0 11
K	...	...	...	...	...	...	...	...	...	...	...	...	three	three	...	...	three	two

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
WINDLASS—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Middle spindle ... *long*	...	...	...	...	...	...	...	...	...	...	A
diameter in the middle	...	...	...	...	...	...	...	...	...	...	B
diameter at the ends	...	...	...	...	...	...	...	...	...	...	C
End spindles ... *long*	...	...	...	...	...	...	...	...	...	...	D
diameter in the middle	...	...	...	...	...	...	...	...	...	...	E
diameter at the ends	...	...	...	...	...	...	...	...	...	...	F
Pall hoops ... *number*	...	...	...	...	...	...	...	...	...	...	G
Each ... *thick*	...	...	...	...	...	...	...	...	...	...	H
Bolt holes ... number	...	...	...	...	...	...	...	...	...	...	I
diameter	...	...	...	...	...	...	...	...	...	...	K
Brass gudgeons	...	...	...	...	...	...	...	...	...	...	L
But if rhodings to have bolts ... *in number*	...	...	...	...	...	...	...	...	...	...	M
diameter	...	...	...	...	...	...	...	...	...	...	N
Cheeks ... *number*	...	...	...	...	...	...	...	...	...	...	O
thick	...	...	...	...	...	...	...	...	...	...	P
broad	...	...	...	...	...	...	...	...	...	...	Q
Bolts in number	...	...	...	...	...	...	...	...	...	...	R
diameter	...	...	...	...	...	...	...	...	...	...	S
Bar holes ... *number in the length*	...	...	...	...	...	...	...	...	...	...	T
square	...	...	...	...	...	...	...	...	...	...	U
Hoops on the ends ... *thick*	...	...	...	...	...	...	...	...	...	...	X
broad	...	...	...	...	...	...	...	...	...	...	Y
Elm or fir facings ... *thick*	...	...	...	...	...	...	...	...	...	...	Z
Iron palls ... *number*	...	...	...	...	...	...	...	...	...	...	A
square	...	...	...	...	...	...	...	...	...	...	B
Upper palls ... *long*	...	...	...	...	...	...	...	...	...	...	C
Lower palls ... *long*	...	...	...	...	...	...	...	...	...	...	D
PALL BITTS—Middle ... *broad*	...	...	...	...	...	...	...	...	...	...	E
thick	...	...	...	...	...	...	...	...	...	...	F
Side ones ... *broad*	...	...	...	...	...	...	...	...	...	...	G
thick	...	...	...	...	...	..	...	...	...	...	H
CANT—from side to side at the windlass bitts ... *square*	...	...	...	...	...	...	...	...	...	...	I
WINCH—Abaft the main mast	...	...	...	...	...	...	...	...	...	...	K
Bitts ... *broad*	...	...	...	...	...	...	...	...	...	...	L
thick	...	...	...	...	...	...	...	...	...	...	M
asunder in the clear	...	...	...	...	...	...	...	...	...	...	N
Spindle ... *up from the deck*	...	...	...	...	...	...	...	...	...	...	O
diameter	...	...	...	...	...	...	...	...	...	...	P
length	...	...	...	...	...	...	...	...	...	...	Q
Chocks ... *long*	...	...	...	...	...	...	...	...	...	...	R
Inner end ... *diameter*	...	...	...	...	...	...	...	...	...	...	S
Outer end ... *diameter*	...	...	...	...	...	...	...	...	...	...	T
Hoop on the ends ... *thick*	...	...	...	...	...	...	...	...	...	...	U
broad	...	...	...	...	...	...	...	...	...	...	X
Pall hoop ... *thick*	...	...	...	...	...	...	...	...	...	...	Y
diameter	...	...	...	...	...	...	...	...	...	...	Z
Pall ... *square*	...	...	...	...	...	...	...	...	...	...	A
long	...	...	...	...	...	...	...	...	...	...	B
Bolt ... *diameter*	...	...	...	...	...	...	...	...	...	...	C
Knees against the bitts ... *sided*	...	...	...	...	...	...	...	...	...	...	D
Arms ... *long*	...	...	...	...	...	...	...	...	...	...	E
Bolts in each arm ... *number*	...	...	...	...	...	...	...	...	...	...	F
diameter	...	...	...	...	...	...	...	...	...	...	G
QUARTER DECK.											
QUARTER DECK—One or two strakes upper edge ... *thick*	0 5	0 5	0 5	0 5	0 4½	0 4½	0 4	0 4	0 4	0 4	H
CLAMPS—Lower edge ... *thick*	0 4	0 4	0 4	0 4	0 3½	0 3½	0 3	0 3	0 3	0 3	I
broad	enough to work to the upper deck ports.										
BEAMS ... *to round up*	0 9	0 8½	0 8½	0 8½	0 8	0 8	0 8	0 8	0 8	0 7¾	K
plank thick	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	L

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	...	...	...	...	...	...	...	...	...	...	...	...	4 6	4 3	...	...	4 0	
B	...	...	...	...	...	...	...	...	...	...	...	...	0 3¾	0 3½	...	...	0 3¼	
C	...	...	...	...	...	...	...	...	...	...	...	...	2 2¾	0 2½	...	...	0 2¼	
D	...	...	...	...	...	...	...	...	...	...	...	...	5 6	5 3	...	...	4 6	4 0
E	...	...	...	...	...	...	...	...	...	...	...	...	0 3¾	0 3½	...	...	0 3	0 2⅞
F	...	...	...	...	...	...	...	...	...	...	...	...	0 2¾	0 2½	...	...	0 2	0 2
G	...	...	...	...	...	...	...	...	...	...	...	...	*four*	*four*	...	...	*two*	*two*
H	...	...	...	...	...	...	...	...	...	...	...	...	0 3	0 2¾	...	...	0 2	0 2
I	...	...	...	...	...	...	...	...	...	...	...	...	*four*	*four*	...	...	*four*	*four*
K	...	...	...	...	...	...	...	...	...	...	...	...	0 0¾	0 0¾	...	...	0 0⅝	0 0⅝
L	...	...	...	...	...	...	...	...	...	...	...	...	*three*	*three*	...	...	*two*	*two*
M	...	...	...	...	...	...	...	...	...	...	...	...	*three*	*three*	...	...	*three*	*three*
N	...	...	...	...	...	...	...	...	...	...	...	...	0 0¾	0 0¾	...	...	0 0⅝	0 0⅝
O	...	...	...	...	...	...	...	...	...	...	...	...	*three*	*three*	...	...	*two*	*two*
P	...	...	...	...	...	...	...	...	...	...	...	...	0 7	0 6½	...	...	0 5	0 4¾
Q	...	...	...	...	...	...	...	...	...	...	...	...	2 10	2 7	...	...	1 0	1 0
R	...	...	...	...	...	...	...	...	...	...	...	...	*three*	*three*	...	...	*two*	*two*
S	...	...	...	...	...	...	...	...	...	...	...	...	0 1⅛	0 1	...	...	0 0⅞	0 0⅞
T	...	...	...	...	...	...	...	...	...	...	...	...	*twelve*	*eleven*	...	...	*nine*	*seven*
U	...	...	...	...	...	...	...	...	...	...	...	...	0 3	0 3	...	...	0 2¾	0 2¾
X	...	...	...	...	...	...	...	...	...	...	...	...	0 0¾	0 0¾	...	...	0 0½	0 0½
Y	...	...	...	...	...	...	...	...	...	...	...	...	0 2½	0 2¼	...	...	0 1¾	0 1¾
Z	...	...	...	...	...	...	...	...	...	...	...	...	0 2	0 1¾	...	...	0 1½	0 1½
A	...	...	...	...	...	...	...	...	...	...	...	...	*six*	*six*	...	...	*two*	*two*
B	...	...	...	...	...	...	...	...	...	...	...	...	0 2	0 1¾	...	...	0 1½	0 1⅜
C	...	...	...	...	...	...	...	...	...	...	...	...	1 6	1 5	...	...	1 1	1 0
D	...	...	...	...	...	...	...	...	...	...	...	...	0 11	0 10				
E	...	...	...	...	...	...	...	...	...	...	...	...	1 4	1 3	...	...	1 2	0 10
F	...	...	...	...	...	...	...	...	...	...	...	...	1 1	1 1	...	...	1 1	0 10
G	...	...	...	...	...	...	...	...	...	...	...	...	1 1	1 1	...	...	1 0	0 9
H	...	...	...	...	...	...	...	...	...	...	...	...	1 1	1 1	...	...	1 0	0 9
I	...	...	...	...	...	...	...	...	...	...	...	...	0 6	0 6	...	...	0 5	
K	...	...	...	...	...	1 8	1 10	1 10	...	...	...	...	...	...	...	1 5	0 9	0 7
L	...	...	...	...	...	0 10	0 10	0 10	...	...	...	...	...	...	...	0 10	0 9	0 8
M	...	...	...	...	...	0 5	0 5	0 5	...	...	...	...	...	...	...	0 4½	0 4	0 4
N	...	...	...	...	...	4 0	4 0	4 0	...	...	...	...	...	...	...	4 0	3 10	3 9
O	...	...	...	...	...	3 6	3 6	3 6	...	...	...	...	...	...	...	3 6	3 6	3 6
P	...	...	...	...	...	0 2¼	0 2⅜	0 2½	...	...	...	...	...	...	...	0 2⅛	0 1⅞	0 1¾
Q	...	...	...	...	...	8 10	8 8	8 8	...	...	...	...	...	...	...	8 0	7 0	7 0
R	...	...	...	...	...	1 6	1 8	1 8	...	...	...	...	...	...	...	1 4	1 1	1 0
S	...	...	...	...	...	0 8½	0 9	0 9	...	...	...	...	...	...	...	0 8	0 7	0 6½
T	...	...	...	...	...	0 6½	0 7	0 7	...	...	...	...	...	...	...	0 6	0 5½	0 5
U	...	...	...	...	...	0 0⅜	0 0⅜	0 0⅜	...	...	...	...	...	...	...	0 0⅜	0 0⅜	0 0¼
X	...	...	...	...	...	0 2	0 2¼	0 2¼	...	...	...	...	...	...	...	0 1¾	0 1⅜	0 1¼
Y	...	...	...	...	...	0 1⅛	0 1¼	0 1¼	...	...	...	...	...	...	...	0 1	0 0⅞	0 0⅞
Z	...	...	...	...	...	0 8	0 9	0 9	...	...	...	...	...	...	...	0 8	0 7¾	0 7½
A	...	...	...	...	...	0 1	0 1⅛	0 1⅛	...	...	...	...	...	...	...	0 1	0 0⅞	0 0⅞
B	...	...	...	...	...	0 7	0 8	0 8	...	...	...	...	...	...	...	0 7	0 6	0 6
C	...	...	...	...	...	0 0¾	0 0¾	0 0¾	...	...	...	...	...	...	...	0 0¾	0 0⅝	0 0⅝
D	...	...	...	...	...	0 3½	0 4	0 4	...	...	...	...	...	...	...	0 3½	0 3	0 3
E	...	...	...	...	...	2 0	2 6	2 6	...	...	...	...	...	...	...	1 9	1 6	1 6
F	...	...	...	...	...	*three*	*three*	*three*	...	...	...	...	...	...	...	*three*	*two*	*two*
G	...	...	...	...	...	0 0¾	0 0⅞	0 0⅞	...	...	...	...	...	...	...	0 0¾	0 0¾	0 0¾
H	0 4	0 3½	0 3	0 2¾	0 4													
I	0 3	0 2½	0 2½	0 2	0 3													
K	0 7½	0 7	0 6½	0 6	0 6													
L	0 3	0 3	0 2½	0 2	0 2½													

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks. GUNS 110	GUNS 98	Of Two Decks. GUNS 80	GUNS 74	GUNS 64	GUNS 50	Frigates. GUNS 44	GUNS 38	GUNS 36	GUNS 32	
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	
QUARTER DECK—*continued.*											
Height from the upperside of the plank to the upperside of the roundhouse beam at middle line……………… *afore..*	6 6	6 3	6 9	6 6	6 6	6 2					
abaft..	6 9	6 5	6 11	6 8	6 8	6 4					
Height from the upperside of the plank to the port sills…. *gun ports……*	1 8	1 8	1 10	1 10	1 7	1 6	1 9	1 7	1 7	1 6	A
carronade ports	…	…	0 11	0 11	…	…	0 11	0 11	0 11	0 11	B
Gun ports…………*number on each side*………	*eight*	*eight*	*eight*	*seven*	*six*	*five*	*four*	*four*	*five*	*three*	C
fore and aft………………	2 9	2 9	2 9	2 9	2 6	2 6	2 6	2 6	2 5	2 4	D
deep………………………	2 7	2 7	2 6	2 6	2 4	2 4	2 4	2 4	2 4	2 4	E
Carronade ports on each side……*number*……..	…	…	…	…	…	…	*four*	*four*	*three*	*two*	F
fore and aft………………	…	…	…	…	…	…	3 4	3 4	3 4	3 4	G
deep………………………	…	…	…	…	…	…	2 7	2 7	2 7	2 7	H
PORT SILLS…………………*deep*……………………	0 6	0 6	0 6	0 6	0 6	0 5	0 5	0 5	0 5	0 5	I
LENGTH from the aftside of the midship stern timber to the foreside of the foremost beam…………	107 0	85 0	95 6	90 0	76 0	76 0	76 6	70 0	65 6	66 6	K
BEAMS.—The quarter-deck beams…………*sided*………	0 10	0 9½	0 10	0 10	0 9½	0 8	0 9	0 9	0 8½	0 8	L
moulded…..	0 9	0 8	0 9	0 9	0 7½	0 7	0 7½	0 7½	0 7	0 7	M
The beam on each side the capstan..*sided*………	…	…	…	…	…	…	0 10	0 10	0 9½	0 9	N
In number………………………………………	30	24	26	26	24	22	24	22	22	22	O
Number of bolts in the scarphs………………	*eight*	*eight*	*eight*	*eight*	*eight*	*six*	*eight*	*eight*	*eight*	*six*	P
diameter………	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0⅞	0 0⅞	0 0¾	0 0¾	Q
Breast beam…………………*sided*…………	1 4	1 3	1 3	1 3	1 2	1 1	1 1	1 1	1 1	1 0	R
deep………………	1 1	1 0	1 1	1 1	0 11½	0 11	0 11½	0 11½	0 11	0 11	S
TRANSOM……………………………*deep*……………	0 7	0 7	0 8	0 8	0 7	0 7	0 7	0 7	0 7	0 7	T
Round up agreeably to the lights below, and	moulded as broad as can be gotten.										
One iron knee at each end, to cast under the beams, and………………*weight*…………	2 0 0	2 0 0	2 1 0	2 1 0	2 0 0	1 3 14	1 3 21	1 3 21	1 3 0	1 2 14	U
To take two bolts before the gallery door, *diameter*………	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	X
Thwartship arm to have three bolts, and be	long enough to take a bolt in the timber next the side.										
KNEES. Every beam to be knee'd at each end with 1 hanging and 1 lodging knee — Hanging knees, *sided*	0 8	0 7	0 7	0 7	0 6½	0 6	0 6½	0 6	0 6	0 6	Y
Hanging arm to reach	down upon the spirketting, 6 inches.										
Thwartship arm, *long*	3 3	3 3	3 3	3 3	3 2	3 2	3 0	3 0	3 0	2 10	Z
To have in each knee bolts……*in number*…….	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*seven*	A
diameter………	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	B
Lodging knees…………………*sided*…………	0 6½	0 6	0 6¼	0 6¼	0 6	0 5½	0 6	0 5½	0 5½	0 5¼	C
Thwartship arm………………*long*…………	3 6	3 6	3 6	3 6	3 4	3 4	3 3	3 3	3 3	3 2	D
Side arm the whole length between the beams, or for three bolts……………*diameter*………	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	E
Ladderway before the capstan….*fore and aft*…	3 2	3 0	3 0	3 0	3 0	2 9	2 8	2 8	2 8	2 8	F
thwartships….	5 4	5 4	5 2	5 2	5 2	5 2	5 0	5 0	5 0	5 0	G
Gratings abaft the capstan to cabin bulkhead, and there athwart………………………………	5 0	5 0	5 0	5 0	5 0	5 0	4 10	4 10	4 10	4 10	H
CAPSTAN PARTNERS…………………………*thick*………	…	…	…	…	…	…	0 6	0 6	0 6	0 6	I
broad………	…	…	…	…	…	…	5 0	5 0	5 0	5 0	K
SCUTTLES.—To frame a long scuttle on each side the main mast, about 22 inches in the clear, and one scuttle on each side abaft the mast for top-tackles……………………………*square*………	3 0	3 0	3 0	3 0	3 0	2 9	2 9	2 9	2 9	2 9	L
COMPANION over the cabin…………… Outside……… *fore and aft*…	…	…	…	…	…	…	2 8	2 8	2 8	2 6	M
thwartships….	…	…	…	…	…	…	4 4	4 4	4 4	4 2	N
CARLINGS.—Two tier on each side……………*broad*…	…	…	0 8	0 7½							
(In other ships under the coamings only) *deep*….	…	…	0 6	0 5½							
LEDGES……………………………………………*broad*…	…	…	0 5	0 4½							
deep…..	…	…	0 4	0 3½							
BRACE BITTS………………Athwartships………………	1 2	1 2	1 2	1 2	1 2	1 1	1 1	1 1	1 1	1 1	O
Head *square*…………………	0 10	0 10	0 10	0 10	0 9½	0 9	0 9	0 9	0 9	0 8	P
Heads above the deck………	3 9	3 9	3 9	3 9	3 7	3 7	3 7	3 7	3 7	3 6	Q
Bolts in the heels, *diameter*…	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	R
Three sheaves in each bitt…………*diameter*….	0 10	0 10	0 9	0 9	0 9	0 8	0 8	0 8	0 8	0 7	S
Inner sheave………………………*thick*……..	0 1¾	0 1¾	0 1¾	0 1¾	0 1½	0 1½	0 1½	0 1½	0 1½	0 1⅜	T

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	ft. in.	ft. in	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
A	1 6	1 6																
B	0 11	0 11	0 11															
C	*two*	*one*																
D	2 4	2 2																
E	2 4	2 2																
F	*two*	*three*	*three*															
G	3 4	3 4	2 6															
H	2 7	2 7	2 7															
I	0 5	0 5	0 4½															
K	56 0	55 0	58 0	37 0	25 6													
L	0 7¾	0 7½	0 7	0 6	0 7													
M	0 6½	0 6	0 5½	0 5	0 5½													
N	0 9	0 8	0 7½															
O	20	20	18	13	*nine*													
P	*six*	*six*	*six*															
Q	0 0¾	0 0¾	0 0¾															
R	1 0	0 11	0 11	0 9	0 10													
S	0 11	0 10	0 9	0 8½	0 9													
T	0 7	0 7	0 7	0 6½	0 7													
U	1 2 7	1 2 0	1 1 14	1 1 0	1 1 14													
X	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾													
Y	0 5¾	0 5½	0 5	0 3¾	0 5½													
Z	2 10	2 10	2 9	2 6	2 9													
A	*seven*	*seven*	*seven*	*six*	*seven*													
B	0 0⅞	0 0¾	0 0¾	0 0⅝	0 0¾													
C	0 5	0 4¾	0 4¼	0 3½	0 4½													
D	3 2	3 2	3 0	2 9	3 0													
E	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾													
F	2 8	2 8	2 6	2 6	2 0													
G	4 10	4 10	4 10	4 8	4 9													
H	4 7	4 7	4 7	4 6	4 7													
I	0 5½	0 5½	0 5															
K	4 10	4 10	4 10															
L	2 9	2 9	2 7															
M	2 6	2 6	2 4															
N	4 0	4 0	4 0															
O	1 0	1 0	0 11															
P	0 8	0 8	0 7½															
Q	3 6	3 6	3 4															
R	0 0¾	0 0¾	0 0¾															
S	0 7	0 7	0 7															
T	0 1¼	0 1¼	0 1¼															

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
Quarter Deck—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Outer sheaves, two..........each *thick*	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	A
Crosspiece..........*broad*	0 8	0 8	0 8	0 8	0 7½	0 7½	0 7	0 7	0 7	0 7	B
deep..	0 6	0 6	0 6	0 6	0 6	0 6	0 6	0 6	0 6	0 5½	C
Upperside above the deck..........	2 0	2 0	2 0	2 0	2 0	1 10	1 10	1 10	1 10	1 10	D
Ends without the bitts..........	1 8	1 8	1 8	1 8	1 8	1 6	1 6	1 6	1 6	1 4	E
Coamings—Ladderway grating, and for capstan partners to be in one length... { ....*broad*	0 9	0 9	0 9	0 9	0 9	0 8	0 10	0 10	0 10	0 9	F
....*deep..*	0 8	0 8	0 8	0 8	0 8	0 7	0 9	0 9	0 9	0 8	G
Scored down upon the beams..........	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 0⅞	H
One bolt in each beam..........*diameter*	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	I
Companion framing..........*thick...*	...	...	...	...	...	...	0 4	0 4	0 4	0 4	K
To stand above the deck..........	...	...	...	...	...	...	0 9	0 9	0 9	0 9	L
Bolt at each corner..........*diameter*	...	...	...	...	...	...	0 0⅞	0 0⅞	0 0⅞	0 0⅞	M
Steering Wheel Stantions..........*broad*	1 3	1 2	1 2	1 2	1 1	1 1	1 1	1 1	1 1	1 1	N
thick	0 7	0 6	0 6	0 6	0 6	0 6	0 5	0 5	0 5	0 5	O
Heads above the deck..........	4 6	4 4	4 0	4 0	4 0	4 0	3 9	3 9	3 9	3 9	P
Barrel..........*length*..........	3 0	3 0	2 9	2 8	2 6	2 6	2 4	2 4	2 4	2 3	Q
diameter { *heads..*	2 4	2 4	2 2	2 2	2 0	1 10	1 9	1 8	1 8	1 7	R
middle	2 2	2 2	2 0	2 0	1 10	1 8	1 7	1 6	1 5	1 4½	S
Spindle..........*square*	0 2	0 2	0 1¾	0 1¾	0 1¾	0 1⅝	0 1⅝	0 1½	0 1½	0 1⅜	T
Waterways..........*thick*.......	0 4	0 4	0 4½	0 4½	0 4	0 4	0 4	0 4	0 4	0 4	U
bearded back	0 0⅜	0 0⅜	0 0⅜	0 0⅜	0 0⅜	0 0⅜	0 0⅜	0 0⅜	0 0⅜	0 0⅜	X
Flat of the Deck, to be of Prussian deal,..........*thick*	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	Y
except English oak plank, which is used next the waterways..........*strakes in number*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	Z
Spirketting—English plank..........*thick*	0 4	0 4	0 4	0 4	0 3½	0 3½	0 3½	0 3½	0 3½	0 3	A
Quickwork—between the ports..........*thick*	0 2½	0 2½	0 2½	0 2½	0 2	0 2	0 2	0 2	0 2	0 2	B
Roughtree rail..........*broad*	...	...	...	...	...	...	0 8	0 8	0 8	0 7	C
deep	...	...	...	...	...	...	0 5	0 5	0 5	0 5	D
Underside above the deck..........	...	...	...	...	...	...	3 9	3 7	3 7	3 6	E
Iron Work to Ports— Carronade Ports { ....*Ring bolts diameter*	...	...	...	...	...	...	0 1¼	0 1¼	0 1¼	0 1⅛	F
..........*Rings in the clear..*	...	...	...	...	...	...	0 5	0 5	0 5	0 4½	G
..........*Eyebolts diameter..*	...	...	...	...	...	...	0 1⅛	0 1⅛	0 1⅛	0 1	H
..........*Eyes in the clear....*	...	...	...	...	...	...	0 2	0 2	0 2	0 1¾	I
Gun Ports....... { ....*Ring bolts, diameter*	0 1⅛	0 1⅛	0 1¼	0 1¼	0 1	0 0⅞	0 1⅛	0 1⅛	0 1⅛	0 1	K
..........*Rings in the clear..*	0 4¼	0 4¼	0 4½	0 4½	0 4	0 3¾	0 4¼	0 4¼	0 4¼	0 4	L
..........*Eyebolts diameter...*	0 1⅛	0 1⅛	0 1¼	0 1¼	0 1	0 0⅞	0 1⅛	0 1⅛	0 1⅛	0 1	M
..........*Eyes in the clear...*	0 1⅞	0 1⅞	0 2	0 2	0 1½	0 1⅜	0 1⅞	0 1⅞	0 1⅞	0 1½	N
Screen Bulkhead—Stiles..........*square*	0 6	0 6	0 6	0 6	0 6	0 5½					
Pillars—Square at the head..........	0 5	0 5	0 5	0 5	0 4¾	0 4½					
Square at the heel..........	0 6	0 6	0 6	0 6	0 5¾	0 5½					
Transom..........*deep*	...	...	0 6	0 6	0 6	0 5	0 5	0 5	0 5	0 4½	O
Knee'd at each end with one iron knee...*cwt*....	...	...	1 1 14	1 1 14	1 1 7	1 1 0	1 1 0	1 1 0	1 1 0	1 0 14	P
Fore and aft arm..........*long...*	...	...	5 6	5 6	5 4	5 4	5 0	5 0	5 0	4 9	Q
Thwartship arm..........*long...*	...	...	3 6	3 6	3 4	3 3	3 3	3 3	3 3	3 2	R
Bolts..........*in number*	...	...	*seven*	*seven*	*seven*	*seven*	*seven*	*seven*	*seven*	*seven*	S
diameter	...	...	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	T
Transom above the taffarel..........*in the clear*	...	...	...	...	...	...	0 11	0 11	0 11	0 10	U
broad	...	...	...	...	...	...	0 11	0 11	0 11	0 10	X
deep..	...	...	...	...	...	...	0 4½	0 4½	0 4½	0 4	Y
Breastwork—Stantions, square..........*heel..*	0 7	0 7	0 7	0 7	0 7	0 6½	0 6½	0 6½	0 6½	0 6¼	Z
head..	0 6	0 6	0 6	0 6	0 6	0 5½	0 5½	0 5½	0 5½	0 6¼	A
Rails..........*thick..*	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	B
Upperside of upper rail above the beam..........	3 6	3 6	3 6	3 6	3 6	3 6	3 6	3 6	3 6	3 4	C
Upperside of lower rail above the beam..........	0 11	0 11	0 11	0 11	0 11	0 11	0 11	0 11	0 11	0 10	D
To have two sheaves under the lower rail in each stantion the fore and aft way.......... { *diameter*	0 6½	0 6½	0 6½	0 6½	0 6½	0 6	0 6	0 6	0 6	0 5½	E
											F
thickness	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 0⅞	G
Framing round the Ladderways to be of wood or iron, viz. { Newels or stantions *square*	0 4½	0 4¼	0 4	0 4	0 4	0 4	0 1¼	0 1¼	0 1¼	0 1¼	H
......*stand above the deck*	3 6	3 6	3 6	3 6	3 6	3 6	3 6	3 6	3 6	3 4	I
rails..........*thick*	0 3	0 3	0 3	0 3	0 3	0 2¾	0 1	0 1	0 1	0 0⅞	K

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	0 1	0 1	0 0⅞															
B	0 6½	0 6½	0 6															
C	0 5½	0 5½	0 5															
D	1 10	1 10	1 8															
E	1 4	1 4	1 3															
F	0 9	0 9	0 8															
G	0 8	0 8	0 7															
H	0 0⅞	0 0⅞	0 0⅞															
I	0 0⅞	0 0¾	0 0¾															
K	0 4	0 4	0 4															
L	0 7	0 7	0 7															
M	0 0⅞	0 0¾	0 0¾															
N	1 0	1 0	0 11	...	...	...	...	...	1 0	1 0	1 0	0 11	0 11					
O	0 4½	0 4½	0 4	...	...	...	...	...	0 5	0 5	0 5	0 4	0 4					
P	3 8	3 8	3 7	...	...	...	...	...	5 6	5 6	5 6	5 6	5 4					
Q	2 2	2 1	2 0	...	...	...	...	...	2 6	2 5	2 4	2 3	2 2					
R	1 6	1 5	1 1	...	...	...	...	...	1 10	1 9	1 8	1 5	1 4					
S	1 4	1 3½	1 3	...	...	...	...	...	1 8	1 7	1 5	1 3	1 2					
T	0 1¼	0 1¼	0 1⅛	...	...	...	...	...	0 1¾	0 1⅝	0 1½	0 1¼	0 1¼					
U	0 4	0 4	0 4	0 3	0 4													
X	0 0⅜	0 0¼	0 0¼	0 0¼	0 0¼													
Y	0 3	0 3	0 2½	0 2	0 2½													
Z	*one*	*one*	*one*															
A	0 3	0 3	0 2½	0 2	0 2½													
B	0 2	0 2	0 1½															
C	0 7	0 6	0 6	...	0 6													
D	0 5	0 5	0 4½	...	0 5													
E	3 6	3 5	3 4	...	3 6													
F	0 1⅛	0 1⅛	0 1															
G	0 4½	0 4½	0 4															
H	0 1	0 1	0 0⅞															
I	0 1¾	0 1¾	0 1½															
K	0 1	0 0⅞	0 0⅞															
L	0 4	0 3¾	0 3¾															
M	0 1	0 0⅞	0 0⅞															
N	0 1½	0 1⅜	0 1⅜															
O	0 4½	0 4¼	0 4															
P	1 0 14	1 0 7	1 0 0															
Q	4 9	4 6	4 3															
R	3 2	3 0	3 0															
S	*seven*	*seven*	*seven*															
T	0 0¾	0 0¾	0 0¾															
U	0 9	0 9	0 8	0 7½														
X	0 9	0 9	0 8	0 7½														
Y	0 4	0 4	0 3½	0 3														
Z	0 6¼	0 6¼	0 5¾															
A	0 5	0 5	0 4¾															
B	0 3	0 2½	0 2½															
C	3 4	3 4	3 3															
D	0 10	0 10	0 9															
E	0 5½	0 5½	0 5¼															
F																		
G	0 0⅞	0 0⅞	0 0¾															
H	0 1¼	0 1¼	0 1⅛															
I	3 4	3 4	3 4															
K	0 0⅞	0 0⅞	0 0¾															

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
QUARTER DECK—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Upperside of the upper rail above the deck.....	3 0	3 0	3 0	3 0	3 0	2 10	2 10	2 10	2 10	2 9	A
Upperside of the lower rail above the coamings	0 7	0 7	0 7	0 7	0 6	0 6	0 6	0 6	0 6	0 6	B
BLOCKS.—Main brace blocks, one on each side *broad*...	1 0	1 0	0 11	0 11	0 11	0 10	0 10	0 10	0 10	0 9	C
deep....	1 1	1 1	1 0	1 0	1 0	0 11	0 11	0 11	0 11	0 10	D
Three sheaves in each............ *diameter*......	0 11	0 11	0 11	0 11	0 10	0 9	0 9	0 9	0 9	0 8½	E
thickness.....	0 1¾	0 1¾	0 1¾	0 1¾	0 1⅝	0 1½	0 1½	0 1½	0 1½	0 1⅜	F
Transporting block, one on each quarter, fitted with one sheave................ *deep*................	...	...	...	...	...	...	0 10	0 10	0 10	0 9	G
diameter............	...	...	...	...	...	...	0 9	0 9	0 9	0 8	H
thick................	...	...	...	...	...	...	0 2¾	0 2¾	0 2¾	0 2½	I
Cavil head blocks..............*long*................	4 0	4 0	3 9	3 9	3 8	3 6					
Three or four on each side afore the round-house... *thick*................	0 8	0 8	0 7	0 7	0 7	0 6½					
deep................	0 9	0 9	0 8	0 8	0 8	0 7½					
diameter............	0 9	0 9	0 8	0 8	0 8	0 7					
Four sheaves, each in.........*thickness*............	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1					
Each block to be bolted with four or more bolts..........................*diameter*............	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾					
SHOT GARLANDS.—The same as on the upper deck.											
IRON WORK.—Ring-bolts...................*diameter*......	0 0⅞	0 0⅞	0 1	0 1	0 0⅞	0 0⅞	0 1	0 1	0 1	0 0⅞	K
One abreast each port in deck, *rings in the clear*	0 3½	0 3½	0 3¾	0 3¾	0 3½	0 3½	0 3¾	0 3¾	0 3¾	0 3½	L
Eye bolts along the spirketting for running rigging abreast the main mast .... *number*.........	*six*	*six*	*six*	*six*	*six*	*six*	*five*	*five*	*five*	*five*	M
diameter	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	N
eyes in the clear	0 2½	0 2½	0 2½	0 2½	0 2¼	0 2¼	0 2¼	0 2¼	0 2¼	0 2	O
Eye-bolts, in number two; one in each midship counter-timber, mizen sheets......... *diameter*........	...	...	...	...	...	...	0 1⅛	0 1⅛	0 1⅛	0 1	P
eyes in the clear	...	...	...	...	...	...	0 2¼	0 2¼	0 2¼	0 2	Q
ROUNDHOUSE.											
ROUNDHOUSE..................................*breadth*.........	1 1	1 1	1 2	1 1	1 1	1 0	...	...	...	...	R
thickness	0 4	0 4	0 4	0 4	0 4	0 4	...	...	...	...	S
CLAMPS.—Bearded at lower edge to.........................	0 3	0 3	0 3¼	0 3¼	0 3	0 3	...	...	...	...	T
Bolted with bolts....................*diameter*........	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	...	...	...	...	U
LENGTH taken from aftside of stern timber to foreside of the foremost beam..............................	60 0	40 0	52 6	51 0	45 0	37 6	...	...	...	...	X
BEAMS..................................to round up............	0 10	0 10	0 9	0 9	0 9	0 8½	...	...	...	...	Y
plank, *thick*..........	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	...	...	...	...	Z
HEIGHT from the plank to the port sills.............. *carronade ports*........	0 11	0 11	0 11	0 11	0 11	0 11					
gun ports...............	...	...	...	...	...	...	...	...	...	...	A
Carronade ports......... *in number*...............	8 *or* 6	*six*	8 *or* 6	8 *or* 6	*six*	*two*					
fore and aft............	3 0	3 0	3 2	3 2	3 0	2 10					
deep....................	2 7	2 7	2 9	2 9	2 7	2 3					
GUN PORTS......................... *in number*...............	...	...	...	...	...	...	...	...	...	...	B
fore and aft............	...	...	...	...	...	...	...	...	...	...	C
deep....................	...	...	...	...	...	...	...	...	...	...	D
Port sills..................*deep*......................	0 9	0 9	0 9	0 9	0 9	0 9	...	...	...	...	E
BEAMS..................................*sided*....................	0 7	0 6¾	0 7	0 7	0 6¾	0 6½	...	...	...	...	F
moulded................	0 6½	0 6	0 6½	0 6½	0 6	0 5½	...	...	...	...	G
in number...............	19	13	16	16	15	15	...	...	...	...	H
Breast beam................*sided*....................	1 0	0 11	1 0	1 0	0 11	0 11	...	...	...	...	I
deep....................	0 10	0 9½	0 10	0 10	0 9½	0 9	...	...	...	...	K
TRANSOM..................................*deep*....................	0 8½	0 7¾	0 8	0 8	0 7½	0 7	...	...	...	...	L
broad....................	0 11	0 10	0 11	0 11	0 10	0 10	...	...	...	...	M
One iron knee at each end; fore and aft arm to cast under the beams, and take one bolt afore the gallery door; thwartship arm, one in the timber next the side.................... *cwt*...........	1 1 0	0 3 21	1 1 0	1 1 0	1 0 0	0 3 21	...	...	...	...	N
Bolts, *number*	*seven*	*seven*	*seven*	*seven*	*seven*	*seven*	...	...	...	...	O
diameter......	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	...	...	...	...	P
KNEES to the BEAMS.—Wood.....................*sided*.........	0 5½	0 5	0 5½	0 5¼	0 5	0 4¾					
Hanging arm to reach on the spirketting	0 6	0 6	0 6	0 6	0 6	0 6					
Thwartship arm.........................*long*.........	2 9	2 7	2 9	2 9	2 7	2 6					

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
—	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	2 9	2 9	2 9															
B	0 6	0 5	0 5															
C	0 9	0 9	0 8½															
D	0 10	0 10	0 9															
E	0 8½	0 8¼	0 7¾															
F	0 1¼	0 1¼	0 1⅛															
G	0 9	0 9	0 8															
H	0 8	0 7	0 6															
I	0 2½	0 2¼	0 2															
K	0 0⅞	0 0¾	0 0¾															
L	0 3¼	0 3	0 3															
M	*five*	*five*	*four*															
N	0 1	0 0⅞	0 0⅞															
O	0 2	0 1⅞	0 1¾															
P	0 1	0 1	0 0⅞															
Q	0 2	0 1⅞	0 1¾															
R	...	...	...	...	...	...	...	...	1 1	1 1	1 0½	1 0	1 0	0 11				
S	...	...	...	...	...	...	...	...	0 4	0 4	0 4	0 4	0 4	0 4				
T	...	...	...	...	...	...	...	...	0 3	0 3	0 3	0 3	0 3	0 3				
U	...	...	...	...	...	...	...	...	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾				
X	...	...	...	...	...	...	...	...	48 0	44 0	42 0	40 0	36 0	34 0				
Y	...	...	...	...	...	...	...	...	0 9	0 9	0 9	0 8½	0 8	0 8				
Z	...	...	...	...	...	...	...	...	0 2½	0 2½	0 2½	0 2	0 2	0 2				
A	...	...	...	...	...	...	...	...	1 3	1 3	1 3							
B	...	...	...	...	...	...	...	...	*six*	*six*	*six*							
C	...	...	...	...	...	...	...	...	2 2	2 2	2 2							
D	...	...	...	...	...	...	...	...	2 1	2 1	2 1							
E	...	...	...	...	...	...	...	...	0 4	0 4	0 4							
F	...	...	...	...	...	...	...	...	0 7	0 7	0 7	0 6½	0 6	0 5				
G	...	...	...	...	...	...	...	...	0 5	0 5	0 5	0 5	0 4½	0 4				
H	...	...	...	...	...	...	...	...	13	13	12	11	10	10				
I	...	...	...	...	...	...	...	...	1 0	1 0	1 0	0 11	0 10	0 9				
K	...	...	...	...	...	...	...	...	0 9	0 9	0 9	0 9	0 8½	0 8				
L	...	...	...	...	...	...	...	...	0 5	0 5	0 5	0 5	0 4½	0 4				
M	...	...	...	...	...	...	...	...	0 10	0 10	0 9	0 9	0 9	0 8				
N	...	...	...	...	...	...	...	...	2 1 0	1 1 14	1 1 0	1 0 0	0 3 21	0 3 7				
O	...	...	...	...	...	...	...	...	*seven*	*seven*	*seven*	*seven*	*seven*	*six*				
P	...	...	...	...	...	...	...	...	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾				

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
Roundhouse—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Bolts in knees……*number*	*seven*	*seven*	*seven*	*seven*	*seven*	*seven*	…	…	…	…	A
diameter	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	…	…	…	…	B
Iron hanging knees to weigh……*each*…	0 3 21	0 3 10	0 3 21	0 3 17	0 3 10	0 3 10	…	…	…	…	C
Lodging knees……*sided*	0 5½	0 5	0 5½	0 5¼	0 5	0 4¾	…	…	…	…	D
Fore and aft arms the length between the beams *thwartship arm long*	3 0	3 0	3 0	3 0	3 0	3 0	…	…	…	…	E
Bolts in the knees……*number*	*six*	*six*	*six*	*six*	*six*	*six*	…	…	…	…	F
diameter	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	…	…	…	…	G
Iron lodging knees to weigh each……	…	…	…	…	…	…	…	…	…	…	H
Brace Bitts—Made of two knees, each……*sided*	0 7½	0 7½	0 7½	0 7½	0 7	0 6½	…	…	…	…	I
To stand above the deck……	3 0	3 0	3 0	3 0	2 10	2 10	…	…	…	…	K
Scored ¾ of an inch on the beams, and bolted with two bolts……*diameter*	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	…	…	…	…	L
To have two sheaves in each……*diameter*	0 9	0 9	0 8	0 8	0 7	0 7	…	…	…	…	M
and *thick*	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	…	…	…	…	N
Instead of a cross-piece to have an iron pin, *diameter*	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	…	…	…	…	O
Companion—Coamings or framing……*thick*…	0 4	0 4	0 4	0 4	0 4	0 4	…	…	…	…	P
To stand above the deck……	0 10	0 10	0 10	0 10	0 9	0 9	…	…	…	…	Q
Fore and aft in the clear……	5 6	5 4	5 2	5 2	5 0	5 0	…	…	…	…	R
Thwartships in the clear……	6 0	6 0	5 9	5 9	5 6	5 6	…	…	…	…	S
Taffarel Knees—The fore and aft arm to be bolted through three beams.											
Midship knee arm against the taffarel……*long*	7 9	7 9	7 6	7 6	7 0	6 6					
sided	0 10	0 9¾	0 9½	0 9½	0 9	0 8					
Knee on each side the midships……*sided*	0 8½	0 8	0 7½	0 7	0 6½	0 6					
Fife rail……*broad*	0 11	0 11	0 11	0 11	0 10	0 10	…	…	…	…	T
deep..	0 4	0 4	0 4	0 4	0 3½	0 3½	…	…	…	…	U
Waterways……*thick*	0 4½	0 4	0 4	0 4	0 4	0 3¾	…	…	…	…	X
Flat……deal……*thick*	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	…	…	…	…	Y
Spirketting……*thick*	0 2½	0 2½	0 2½	0 2½	0 2½	0 2	…	…	…	…	Z
Roughtree rail……*broad*	0 8	0 8	0 8	0 8	0 8	0 8	…	…	…	…	A
deep..	0 6	0 5½	0 6	0 6	0 5	0 5	…	…	…	…	B
Underside above the deck……	3 7	3 7	3 9	3 9	3 7	3 6	…	…	…	…	C
Birthing up the underside of roughtree rail, deal *thick*	0 2	0 2	0 2	0 2	0 2	0 2					
Ironwork to the Ports, &……*Ring bolts in diameter*	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	…	…	…	…	D
Rings in the clear…	0 4½	0 4½	0 4½	0 4½	0 4¼	0 4¼	…	…	…	…	E
Eye bolts diameter…	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	…	…	…	…	F
Eyes in the clear…	0 2	0 2	0 2	0 2	0 1¾	0 1¾	…	…	…	…	G
Eye bolts along the spirketting abreast the mizen mast for the rigging { *number*…	*five*	*five*	*five*	*five*	*five*	*five*	…	…	…	…	H
{ *diameter*…	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	…	…	…	…	I
{ *eyes in the clear*	0 2	0 2	0 2	0 2	0 2	0 1¾	…	…	…	…	K
Eye bolts, two, one in each midship counter timber for mizen sheets { *diameter*…	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	…	…	…	…	L
{ *eyes in the clear*	0 2¼	0 2¼	0 2¼	0 2¼	0 2	0 2	…	…	…	…	M
Stantions at fore part of the roundhouse { square head…	0 5	0 5	0 5	0 5	0 4¾	0 4¾	…	…	…	…	N
{ heel…	0 6	0 6	0 6	0 6	0 5¾	0 5¾	…	…	…	…	O
Rail……*thick*	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	…	…	…	…	P
Upper side above the beam……	0 11	0 11	0 11	0 11	0 11	0 11	…	…	…	…	Q
Upperside of upper rail above the beam……	…	…	…	…	…	…	…	…	…	…	R
Main Brace Blocks…One on each side { ……*broad*	1 0	1 0	0 11	0 11	0 11	0 10	…	…	…	…	S
{ ……*deep.*	1 1	1 1	1 0	1 0	1 0	0 11	…	…	…	…	T
Fitted with three sheaves each……*diameter*	0 11	0 11	0 11	0 11	0 10	0 9	…	…	…	…	U
thick…	0 1¾	0 1¾	0 1¾	0 1¾	0 1⅝	0 1½	…	…	…	…	X
Transporting Blocks { One on each quarter……*deep*…	0 11	0 11	0 11	0 11	0 10	0 10	…	…	…	…	Y
Fitted with one sheave each { ……*diameter*	0 10	0 10	0 10	0 10	0 9	0 9	…	…	…	…	Z
{ ……*thick*…	0 3	0 3	0 3	0 3	0 3	0 2¾	…	…	…	…	A
FORECASTLE.											
Forecastle Clamps……*thick upper edge*…	0 5	0 5	0 5	0 5	0 4½	0 4½	0 4	0 4	0 4	0 4	B
bearded to lower edge to	0 4	0 4	0 4	0 4	0 3½	0 3½	0 3½	0 3	0 3	0 3	C

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
A	...	...	...	...	...	...	...	...	*six*	*six*	*six*	*four*	*four*	*four*				
B	...	...	...	...	...	...	...	...	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅝				
C	...	...	...	...	...	...	...	...	0 3 20	0 3 20	0 3 10	0 2 21	0 2 14	0 2 7				
D	...	...	...	...	...	...	...	...	0 5	0 4¾	0 4¾	0 4½	0 4¼	if wood				
E	...	...	...	...	...	...	...	...	2 9	2 9	2 7	2 6	2 6					
F	...	...	...	...	...	...	...	...	*four*	*four*	*four*	*four*	*four*	Dog bolts through the side.				
G	...	...	...	...	...	...	...	...	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾					
H	...	...	...	...	...	...	...	...	0 3 14	0 3 0	0 2 14	0 2 7	0 2 0					
I	...	...	...	...	...	...	...	...	0 7	0 6½	0 6	0 5¾	0 5½	0 5	0 5			
K	...	...	...	...	...	...	...	...	2 10	2 10	2 10	2 9	2 9	2 9	2 9			
L	...	...	...	...	...	...	...	...	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾			
M	...	...	...	...	...	...	...	...	0 7	0 7	0 7	0 6½	0 6	0 5½	0 5			
N	...	...	...	...	...	...	...	...	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 0¾			
O	...	...	...	...	...	...	...	...	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛			
P	...	...	...	...	...	...	...	...	0 4	0 4	0 4	0 4	0 3½	0 3½	0 3			
Q	...	...	...	...	...	...	...	...	0 9	0 9	0 9	0 9	0 7	0 7	0 5			
R	...	...	...	...	...	...	...	...	2 2	2 2	2 2	2 0	2 0	1 10	1 9			
S	...	...	...	...	...	...	...	...	5 6	5 6	5 6	5 2	5 2	5 0	4 9			
T	...	...	...	...	...	...	...	...	0 10	0 10	0 10	0 9	0 9	0 8	0 8			
U	...	...	...	...	...	...	...	...	0 3½	0 3½	0 3½	0 3¼	0 3¼	0 3	0 2¾			
X	...	...	...	...	...	...	...	...	0 4	0 4	0 4	0 3½	0 3½	0 3	0 3			
Y	...	...	...	...	...	...	...	...	0 2½	0 2½	0 2½	0 2	0 2	0 2	0 2			
Z	...	...	...	...	...	...	...	...	0 2½	0 2½	0 2½	0 2	0 2	0 2	0 1¾			
A	...	...	...	...	...	...	...	...	0 7	0 7	0 6	0 6	0 5½	0 5½	0 5			
B	...	...	...	...	...	...	...	...	0 5	0 5	0 4½	0 4½	0 4	0 4	0 4			
C	...	...	...	...	...	...	...	...	3 0	3 0	3 0	3 0	3 0	3 0	3 0			
D	...	...	...	...	...	...	...	...	0 0⅞	0 0⅞	0 0⅞							
E	...	...	...	...	...	...	...	...	0 3½	0 3½	0 3½							
F	...	...	...	...	...	...	...	...	0 0¾	0 0¾	0 0¾							
G	...	...	...	...	...	...	...	...	0 1½	0 1½	0 1½							
H	...	...	...	...	...	...	...	...	*five*	*five*	*five*	*five*	*four*	*four*	*four*			
I	...	...	...	...	...	...	...	...	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾			
K	...	...	...	...	...	...	...	...	0 2	0 2	0 2	0 1¾	0 1¾	0 1⅝	0 1⅝			
L	...	...	...	...	...	...	...	...	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 0¾			
M	...	...	...	...	...	...	...	...	0 2	0 2	0 2	0 1¾	0 1¾	0 1¾	0 1¾			
N	...	...	...	...	...	...	...	...	0 5	0 5	0 5	0 4¾	0 4½	0 4	0 4			
O	...	...	...	...	...	...	...	...	0 6	0 6	0 6	0 5¾	9 5½	0 5	0 5			
P	...	...	...	...	...	...	...	...	0 2½	0 2½	0 2½	0 2½	0 2¼	0 2	0 2			
Q	...	...	...	...	...	...	...	...	0 11	0 11	0 11	0 10	0 9	0 9	0 9			
R	...	...	...	...	...	...	...	...	3 2	3 2	3 2	3 2	3 0	3 0	3 0			
S	...	...	...	...	...	...	...	...	0 10	0 10	0 10	0 9	0 9	0 7	0 7			
T	...	...	...	...	...	...	...	...	0 11	0 11	0 11	0 10	0 10	0 8	0 8			
U	...	...	...	...	...	...	...	...	0 9	0 9	0 9	0 8	0 8	0 7	0 7			
X	...	...	...	...	...	...	...	...	0 1½	0 1½	0 1½	0 1⅜	0 1⅜	0 1¼	0 1⅛			
Y	...	...	...	...	...	...	...	...	0 10	0 10	0 10	0 9	0 9	0 9	0 8			
Z	...	...	...	...	...	...	...	...	0 9	0 9	0 9	0 8	0 8	0 7	0 6			
A	..	...	...	...	...	...	...	...	0 2¾	0 2¾	0 2⅝	0 2½	0 2½	0 2½	0 2¼			
B	0 3½	0 3½	0 3	0 2½	0 3	...	...	...	0 4	0 4	0 4	0 3½	0 3	0 3				
C	0 3	0 3	0 2½	0 2	0 2½	...	...	...	0 3½	0 3½	0 3½	0 3	0 2½	0 2½				

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
Forecastle—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Forecastle Clamps ... *broad*	...	To work down to the ports.				...	...	...	...	...	A
Beams ... *to round up*	0 8	0 7	0 8	0 8	0 7	0 7	0 7	0 7	0 6½	0 6	B
flat, *thick*	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 9	0 3	C
Height from the flat to the port sills ... *gun ports*	1 9	1 9	1 11	1 11	1 8	1 6	1 8	1 8			
carronade ports	0 11	0 11	0 11	0 11	0 11	0 11	0 11	0 11	0 11	0 11	D
Carronade Ports ... *number*	*two*	*two*	...	*two*	*two*	*two*	*two*	*two*	*two*	*two*	E
fore and aft	3 4	3 4	...	3 4	3 2	3 2	3 4	3 4	3 4	3 2	F
Gun Ports ... *number*	*four*	*two*	*three*	*two*	*two*	*two*	*two*	*two*	*two*		
fore and aft	2 9	2 9	3 0	3 0	2 7	2 5	2 9	2 7	2 7		
Length on the Forecastle	45 0	40 0	49 0	50 0	36 6	33 0	40 0	37 3	36 0	32 0	G
Beams to be ... *sided*	0 10	0 9½	0 9½	0 9½	0 9¼	0 8	0 9	0 8½	0 8	0 7	H
moulded	0 9	0 8½	0 9½	0 9½	0 8	0 7	0 7½	0 7	0 7	0 6	I
in number	*twelve*	*eleven*	*thirteen*	*thirteen*	*ten*	*ten*	*eleven*	*ten*	*ten*	*nine*	K
Number of bolts in the scarphs	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*seven*	L
diameter	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	M
Breast beam ... *sided*	1 3	1 2	1 2	1 2	1 1	1 0	1 0	1 0	1 0	1 0	N
deep	1 1	1 0	1 1	1 1	0 11½	0 11	0 11½	0 11½	0 11	0 11	O
Cat beam ... *broad*	2 10	2 9	3 0	3 0	2 9	2 6					
deep	0 11	0 10	0 10½	0 10½	0 10	0 9					
Bolts at every 20 inches asunder, *diameter*	0 1	0 1	0 1	0 1	0 1	0 0⅞					
Rabbet on the after edge ... *deep*	0 4	0 4	0 4	0 4	0 4	0 4					
broad	0 5	0 5	0 5	0 5	0 5	0 4					
Rise beam ... *sided*	...	...	...	...	...	...	...	...	...	...	P
moulded	...	...	...	...	...	...	...	...	...	...	Q
Beam under the bowsprit ... *sided*	...	...	...	...	...	...	...	...	...	...	R
moulded	...	...	...	...	...	...	...	...	...	...	S
number	...	...	...	...	...	...	...	...	...	...	T
Catheads ... *fore and aft*	1 8	1 7	1 6	1 5½	1 5	1 4	1 3	1 4	1 3	1 2	U
deep	1 6	1 5	1 5	1 4½	1 3	1 2	1 1	1 2	1 1	1 0	X
To stand square with the bow, and to stive upwards in every foot	0 5	0 5	0 6	0 6	0 6	0 6	0 6	0 5½	0 5½	0 5½	Y
Length without board *(or sufficient to swing the anchor clear of the bow)*	9 0	8 6	9 0	8 6	7 9	7 6	7 0	7 6	7 6	7 0	Z
Length within board from the outside of the timber	9 6	9 0	9 0	8 6	8 0	7 9	9 6	9 0	9 0	8 9	A
Catheads and cross-chock bolted through the cat-beam ... *diameter*	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 1	0 1	0 0⅞	B
In the outer end of each to have sheaves	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	C
diameter	1 4	1 3	1 3	1 3	1 2	1 1	1 1	1 1	1 1	1 0	D
thickness	0 2⅜	0 2¼	0 2¼	0 2¼	0 2⅛	0 2	0 2	0 2	0 2	0 1⅞	E
Knee at the aftside of the cathead, *sided*	0 9	0 8	0 7½	0 7¼	0 6¾	0 6½	0 6¼	0 6	0 6	0 5½	F
Fore and aft arm ... *long*	5 6	5 3	4 9	4 9	4 9	4 9	4 7	4 7	4 7	4 3	G
Thwartship arm ... *long*	3 9	3 7	3 6	3 6	3 3	3 0	3 0	2 9	2 9	2 6	H
Bolts ... *in number*	*seven*	*seven*	*seven*	*seven*	*seven*	*seven*	*six*	*six*	*six*	*six*	I
diameter	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 1	0 0⅞	K
Hanging knees, one under each end of the cat beam ... *sided*	0 11	0 10	0 11	0 11	0 10	0 10	...	...	...	...	
if iron, to weigh	1 2 0	1 1 0	1 2 0	1 2 0	1 1 0	1 0 14					
Every beam of the forecastle to have one hanging knee at each end ... *sided*	0 8	0 7½	0 8	0 8	0 7	0 6½	0 6½	0 6	0 6	0 5¾	L
thwartship arm long, and hanging arm to reach the spirketting	3 5	3 5	3 3	3 3	3 0	3 0	3 0	2 10	2 10	2 10	M
Bolts in each knee ... *number*	*eight*	*eight*	*eight*	*eight*	*eight*	*seven*	*seven*	*seven*	*seven*	*seven*	N
diameter	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	O
Lodging knees, one on each side, abaft the cat beam ... *sided*	0 9	0 8	0 8	0 7	0 6½	0 6	...	...	...	...	
One on each side, abaft every forecastle beam, *sided*	0 6½	0 6	0 6	0 6	0 5½	0 5¼	0 5	0 5	0 5	0 4¾	P
Thwartship arm ... *long*	3 9	3 9	3 7	3 7	3 4	3 4	3 4	3 2	3 2	3 2	Q
Bolts in each knee ... *in number*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	R
diameter	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	S
Ladderway.—Fore part of the forecastle, *fore and aft*	2 2	2 2	2 0	2 0	1 10	1 10					
thwartships	5 9	5 9	5 7	5 7	5 6	5 6					

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	...	...	...	0 10	1 2	...	...	...	1 2	1 2	1 1	1 0	1 0	0 11				
B	0 6	0 6	0 6	0 5	0 6	...	...	...	0 9	0 9	0 9	0 8	0 7	0 6				
C	0 3	0 3	0 2½	0 2	0 2½	...	...	...	0 2½	0 2½	0 2½	0 2½	0 2½	0 2				
D	0 11	0 11	0 9															
E	*two*	*two*	*two*															
F	3 2	3 2	2 10															
G	29 6	28 6	25 6	9 6	14 0	...	...	...	20 0	19 0	17 0	21 6	21 0	20 6				
H	0 6¾	0 6½	0 6½	0 6	0 8	...	...	...	0 10	0 10	0 10	0 9	0 7	0 6				
I	0 5¾	0 5½	0 5	0 4½	0 6	...	...	...	0 8	0 8	0 8	0 7	0 6	0 5				
K	*nine*	*nine*	*eight*	*five*	*five*	...	...	...	*three*	*three*	*three*	*six*	*six*	*five*				
L	*six*	*six*	*six*															
M	0 0¾	0 0¾	0 0¾															
N	0 11	0 11	0 10	0 9	0 10	...	...	...	1 0	1 0	1 0	0 11	0 11	0 10				
O	0 11	0 10	0 9	0 8½	0 9	...	...	...	0 11	0 11	0 11	0 10	0 10	0 9				
P	...	...	...	...	...	...	...	...	1 1	1 1	1 0	0 11						
Q	...	...	...	...	...	...	...	...	0 10	0 10	0 10	0 9						
R	...	...	...	...	...	...	...	...	0 11	0 11	0 10	0 10						
S	...	...	...	...	...	...	...	...	0 9	0 9	0 9	0 9						
T	...	...	...	...	...	...	...	...	*four*	*four*	*four*	*four*						
U	1 1	1 1	1 0	0 8	0 10	0 9	0 9½	0 9	1 4	1 3	1 2	1 1	1 0	0 11	0 10½	0 8	0 9½	0 7
X	0 11	0 11	0 10	0 7	0 10	0 8	0 8	0 8	1 2	1 2	1 1	1 0	0 11	0 10	0 10	0 7	0 9	0 7
Y	0 5½	0 5½	0 5	0 4	0 4	0 3	0 3½	0 3½	0 4	0 4	0 4	0 5	0 5	0 5	0 5	0 5	0 5	0 5
Z	7 0	7 0	6 9	5 6	6 0	4 9	5 6	5 0	6 0	6 0	6 0	5 6	5 0	4 10	4 9	4 7	4 0	3 0
A	8 6	8 6	8 0	6 6	7 6	...	...	...	8 0	8 0	7 9	7 0	7 0	6 9				
B	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0⅞	0 0¾	0 0¾	0 0¾	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾
C	*three*	*three*	*three*	*two*	*three*	*two*	*two*	*two*	*three*	*three*	*three*	*three*	*three*	*three*	*two*	*two*	*two*	*two*
D	0 11	0 10	0 9	0 7	0 9	0 8	0 8	0 8	1 1	1 1	1 1	1 0	0 10	0 8½	0 8	0 7½	0 8	0 7
E	0 1¾	0 1⅝	0 1⅜	0 1⅛	0 1¼	0 1¼	0 1¼	0 1¼	0 1¾	0 1¾	0 1¾	0 1½	0 1¼	0 1⅛	0 1⅛	0 1	0 1	0 1
F	0 5	0 4¾	0 4½															
G	4 3	4 0	3 9															
H	2 6	2 3	2 3															
I	*six*	*six*	*six*															
K	0 0⅞	0 0⅞	0 0¾															
L	0 5½	0 5	0 4¾	0 3¾	0 5	iron weight, *cwt.*			1 0 0	0 3 21	0 3 14	0 3 0	0 3 0	0 2 21				
M	2 9	2 9	2 9	2 7	2 9	...	...	...	2 10	2 10	2 9	2 9	2 7	2 6				
N	*seven*	*seven*	*seven*	*six*	*six*	...	...	...	*six*	*six*	*six*	*six*	*six*	*six*				
O	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0⅞	...	...	...	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾				
P	0 4¾	0 4¾	0 4½	0 3½	0 5	...	...	...	0 5½	0 5	0 5	0 4½	0 4	0 3¾				
Q	3 0	3 0	3 0	2 9	3 0	...	...	...	3 3	3 3	3 0	3 0	3 0	2 10				
R	*six*	*six*	*six*	*four*	*four*	...	...	...	*six*	*six*	*six*	*six*	*six*	*four*				
S	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅞	...	...	...	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾				

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
Forecastle—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Scuttles for the steam gratings fore and aft as the beams will admit	...	...	...	...	...	...	...	...	...	...	A
thwartships	5 9	5 9	5 7	5 7	5 6	5 6	4 9	4 4	4 0	3 9	B
Coamings to ditto *broad*	0 6	0 6	0 6	0 6	0 5½	0 5½	0 5	0 5	0 5	0 5	C
deep	0 7	0 7	0 7	0 7	0 6	0 6	0 6	0 6	0 6	0 6	D
Chimney funnel coamings *thick*	0 5	0 5	0 4½	0 4½	0 4½	0 4	0 4	0 4	0 4	0 4	E
square in the clear	2 9	2 9	2 6	2 6	2 4	2 4	2 4	2 4	2 4	2 2	F
Upperside to stand above the upper deck	8 0	8 0	7 9	7 9	7 9	7 7	7 6	7 6	7 6	7 4	G
Bolted at each corner one bolt *diameter*	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	H
Fore Jear and Topsail Sheet Bitts *square*	1 1	1 0	1 0	1 0	0 11	0 10	0 9	0 9	0 9	0 8½	I
Heads above the deck	3 10	3 10	3 10	3 10	3 9	3 9	3 7	3 7	3 7	3 6	K
To have blocks left on the outsides *thick*	0 3½	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	L
To have sheaves, two in each bitt *diameter*	1 1	1 0	1 0	1 0	0 11	0 10	0 9	0 9	0 9	0 8	M
For the jears *thickness*	0 3¼	0 3	0 3	0 3	0 2¾	0 2⅜	0 2⅜	0 2¼	0 2¼	0 2⅛	N
In cheek block *thickness*	0 2	0 1¾	0 1¾	0 1¾	0 1⅝	0 1½	0 1¼	0 1¼	0 1¼	0 1⅛	O
In the heels one sheave in each *diameter*	0 11	0 10½	0 10½	0 10½	0 10	0 9					
thickness	0 3¾	0 3½	0 3½	0 3½	0 3¼	0 3					
Cross-pieces—One to each *deep*	0 8	0 7	0 7	0 7	0 6	0 6	0 6	0 5½	0 5½	0 5½	P
broad	0 10	0 9	0 9	0 9	0 8	0 8	0 8	0 7½	0 7½	0 7½	Q
Scored on the bitts	0 1¾	0 1½	0 1½	0 1½	0 1⅜	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	R
Bolted, one bolt in each bitt *diameter*	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	S
Where there are no cross-pieces to have iron pins *diameter*	...	...	...	...	...	...	...	...	...	...	T
Waterways *thick*	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	U
Strakes of English plank next the waterways *number*	*two*	*two*	*two*	*two*	*two*	*two*	*one*	*one*	*one*	*one*	X
The remainder of the flat, to be of Prussian deal *of*	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	Y
Spirketting—To be *thick*	0 3	0 3	0 3½	0 3½	0 3	0 3	0 3	0 3	0 3	0 3	Z
Timber Heads—To be above the planksheer	1 9	1 8	1 8	1 8	1 8	1 8	1 8	1 6	1 6	1 6	A
Timber-head for anchor-stopper above planksheer	2 9	2 7	2 6	2 6	2 5	2 4	2 3	2 2	2 2	2 2	B
Planksheer *thick*	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	C
Broad enough for a moulding outside and in.											
Cat Blocks *broad*	1 1	1 1	1 1	1 1	1 0	1 0	0 11	0 11	0 11	0 10	D
deep	0 11	0 11	0 11	0 11	0 10	0 10	0 9	0 9	0 9	0 8	E
Sheave *diameter*	1 1	1 0	1 0	1 0	0 11	0 11	0 10	0 10	0 10	0 9	F
thickness	0 2⅜	0 2¼	0 2¼	0 2¼	0 2⅛	0 2	0 2	0 2	0 2	0 1⅞	G
Breasthook over the Bowsprit *sided*	...	...	...	...	...	...	0 9½	0 9	0 9	0 8½	H
length	4 9	4 6	4 3	4 0	4 0	3 10	13 6	13 0	13 0	12 6	I
Bolts *in number*	*six*	*six*	*six*	*six*	*six*	*six*	*twelve*	*twelve*	*twelve*	*twelve*	K
diameter	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 0⅞	L
Large ships to have an iron hook under the bowsprit *weight*	1 3 0	1 2 21	1 2 14	1 2 0	1 1 21	1 1 0					
Breast Stantions—At after end of forecastle *square*	0 6	0 6	0 6	0 6	0 6	0 5	0 5	0 5	0 5	0 4¾	M
Stand above the beam	2 0	1 11	1 10	1 10	1 9	1 9	1 8	1 8	1 8	1 8	N
Rail *thick*	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	O
broad	0 11	0 11	0 11	0 11	0 10	0 10	0 10	0 9	0 9	0 9	P
Underside of the rail above the beam	0 11	0 11	0 11	0 11	0 10	0 10	0 10	0 9	0 9	0 9	Q
To sheaves in each stantion under the rail, *diameter*	0 5½	0 5½	0 5½	0 5½	0 5½	0 4½	0 4½	0 4½	0 4½	0 4½	R
thickness	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 0⅞	S
Belfry Stantions *broad*	2 3	2 2	2 1	2 1	2 0	2 0	1 10	1 10	1 10	1 10	T
thick	0 6	0 6	0 6	0 6	0 6	0 5	0 5	0 5	0 5	0 4¾	U
Asunder athwartships in the clear	2 3	2 2	2 1	2 1	2 0	2 0	1 10	1 10	1 10	1 10	X
To stand above the beams	3 0	2 10	2 10	2 10	2 9	2 9	2 7	2 7	2 7	2 7	Y
Top *thick*	0 6	0 6	0 6	0 6	0 5	0 5	0 5	0 5	0 5	0 4½	Z
Shot Racks—As on the quarter deck.											
Iron-work to the Ports, as on quarter deck.											

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
—	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
A	...	...	...	...	...	...	...	...	7 0	7 0	7 0							
B	3 6	3 0	3 0	2 9	3 0	...	...	...	4 8	4 8	4 8							
C	0 5	0 5	0 4½	0 4	0 4	...	...	...	0 5	0 5	0 5							
D	0 6	0 6	0 6	0 5	0 6	...	...	...	0 6	0 6	0 6							
E	0 4	0 4	0 3½	0 3	0 3½													
F	2 2	2 0	2 0	1 10	1 10													
G	7 4	7 4	7 2	6 9	7 0													
H	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾													
I	0 8	0 8	0 7½	0 7	0 7½													
K	3 6	3 3	3 0	2 9	2 10													
L	0 3	0 3	0 2½	...	0 2½													
M	0 8	0 8	0 7	0 7	0 7													
N	0 2⅛	0 2	0 1⅞	0 1½	0 1⅝													
O	0 1⅛	0 1	0 1	0 0¾	0 0⅞													
P	0 5¼	0 5	0 4½															
Q	0 7¼	0 7	0 6½															
R	0 1¼	0 1¼	0 1¼															
S	0 0⅞	0 0¾	0 0¾															
T	...	...	...	0 1⅛	0 1¼													
U	0 4	0 4	0 4	0 3	0 4	...	...	...	0 4	0 4	0 4	0 3½	0 3	0 3				
X	*one*	*one*	*one*	...	*one*	...	...	...	*one*	*one*	*one*	*one*	*one*	*one*				
Y	0 3	0 3	0 2½	0 2	0 2½	...	...	...	0 2½	0 2½	0 2½	0 2½	0 2	0 2				
Z	0 3	0 2½	0 2½	0 2	0 2½	...	...	...	0 3	0 3	0 3	0 3	0 2½	0 2½				
A	1 4	1 4	1 3	1 0	1 2	...	...	...	1 8	1 8	1 8	1 6	1 6	1 6	1 4	1 4	1 2	1 0
B	2 2	2 1	2 0	1 8	1 10	...	...	...	2 4	2 4	2 4	2 2	2 2	2 0	2 0	1 10	1 8	1 6
C	0 3	0 3	0 2½	0 2	0 2½	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 2½
D	0 10	0 9	0 9	0 8	0 9	0 8	0 8	0 8	0 10	0 10	0 10	0 9	0 9	0 8	0 8	0 8	0 8	0 8
E	0 8	0 8	0 7	0 6	0 7	0 6	0 6	0 6	0 8	0 8	0 8	0 7	0 7	0 6	0 6	0 6	0 6	0 5
F	0 9	0 8	0 8	0 7	0 8	0 7	0 7	0 7	0 9	0 9	0 9	0 8	0 8	0 7	0 7	0 7	0 7	0 7
G	0 1¾	0 1⅝	0 1⅜	0 1⅛	0 1¼	0 1¼	0 1¼	0 1¼	0 1¾	0 1¾	0 1¾	0 1⅝	0 1½	0 1⅜	0 1¼	0 1¼	0 1⅛	0 1⅛
H	0 8	0 8	0 7¾	0 6	0 6½	0 6	0 6	0 6	0 11½	0 11	0 10	0 9	0 8					
I	12 3	12 0	11 0	9 6	10 0	9 0	9 6	9 0	15 0	15 0	14 6	13 0	12 0					
K	*two*	*ten*	*eight*	*six*	*eight*	*six*	*six*	*six*	*twelve*	*twelve*	*twelve*	*twelve*	*ten*					
L	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 1¼	0 1¼	0 1⅛	0 1	0 1					
M	0 4¾	0 4½	0 4¼	0 4	0 4	...	...	...	0 5	0 5	0 5	0 5	0 4½	0 4½				
N	1 8	1 7	1 6	1 6	1 6	...	...	...	1 9	1 9	1 8	1 8	1 7	1 6				
O	0 3	0 2½	0 2½	0 2	0 2¼	...	...	...	0 3	0 3	0 3	0 3	0 2½	0 2				
P	0 9	0 9	0 8	0 8	0 8	...	...	...	0 10	0 10	0 9	0 9	0 8	0 8				
Q	0 9	0 9	0 8	0 8	0 8	...	...	...	0 10	0 10	0 9	0 9	0 9	0 8				
R	0 4½	0 4	0 4	0 4	0 4	...	...	...	0 5	0 5	0 4½	0 4½	0 4	0 4				
S	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	...	...	...	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞				
T	1 9	1 9	1 8	1 6	1 7	...	...	...	1 10	1 10	1 10	1 8	1 8	1 7				
U	0 4¾	0 4½	0 4¼	0 4	0 4¼	...	...	...	0 4½	0 4½	0 4½	0 4	0 4	0 4				
X	1 9	1 9	1 8	1 6	1 7	Iron	frame	...	1 10	1 10	1 10	1 8	1 8	1 7	Iron	frame		
Y	2 6	2 6	2 5	2 3	2 4	...	...	...	2 6	2 6	2 6	2 5	2 4	2 2				
Z	0 4½	0 4	0 4	0 4	0 4	...	...	...	0 5	0 5	0 5	0 4½	0 4	0 4				

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
Forecaste—*continued.*	*ft. in.*	*ft. in*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Eye-bolts round the foremast..*number*..........	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	*eight*	A
diameter..........	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 0⅞	B
eyes in the clear...	0 2¼	0 2¼	0 2¼	0 2¼	0 2¼	0 2⅛	0 2	0 2	0 2	0 2	C
Eye-bolts in the spirketting abreast the mast, *number*..........	*six*	*six*	*six*	*six*	*six*	*six*	*five*	*five*	*five*	*five*	D
diameter..........	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	E
eyes in the clear...	0 2½	0 2½	0 2½	0 2½	0 2¼	0 2¼	0 2¼	0 2¼	0 2¼	0 2	F
Eye-bolt for main topmast stay....*diameter*......	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	G
eye in the clear...	0 3	0 2¾	0 2¾	0 2¾	0 2¾	0 2⅝	0 2⅝	0 2⅝	0 2⅝	0 2½	H
BEAK-HEAD.											
Beakhead.—Length from foreside of the stem to foreside of the bulkhead	9 0	8 6	7 6	7 6	6 9	6 6					
Stantions, each...........................*square*..........	0 7	0 7	0 6¾	0 6½	0 6	0 6					
Faced on to the cat-beam	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 0¾					
And bolted with two bolts......*in diameter*.......	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾					
The stantions next the side spaced to form a round house in the clear........................	3 0	3 0	3 0	3 0	2 10	2 9					
The next stantion a chase port athwartships......	2 6	2 6	2 6	2 6	2 5	2 4					
The other stantions asunder about................	2 6	2 6	2 6	2 6	2 4	2 4					
Carlings.—One on each side of the bowsprit...*broad*.....	1 2	1 2	1 1	1 1	1 0	1 0					
deep......	1 0	1 0	0 11	0 11	0 10	0 10					
Flat.......................................*thick*......	0 3	0 3	0 3	0 3	0 3	0 2½					
Bulkheads outside and inside to be of deal.......	0 1½	0 1½	0 1½	0 1½	0 1¼	0 1¼					
Plank-sheer over the birthing..........*thick*......	0 3	0 3	0 3	0 3	0 3	0 2½					
Fife rail over the plank-sheer..........*thick*......	0 2½	0 2½	0 2½	0 2½	0 2½	0 2					
Opening between in the clear......................	1 0	0 11	0 11	0 11	0 10	0 9					
Stantions to form timber heads above the fife rail..	0 9	0 8	0 8	0 8	0 7	0 7					
To have two sheaves in each midship stantion, and one in every other..........*diameter*......	0 6	0 6	0 6	0 6	0 5½	0 5					
thickness......	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1					
HEAD.											
Length from the foreside of the stem to the fore part of the knee................................	18 3	17 6	15 6	15 0	13 0	10 9	12 10	11 6	11 3	10 6	I
Breast of the scroll or figure distant from the stem	18 6	17 9	15 6	15 9	13 4	10 9	12 3	11 9	11 6	10 9	K
Hair bracket, the fore part abaft the breast of the figure..	4 6	5 0	3 9	3 9	3 9	2 9	2 9	2 9	2 7	2 6	L
Height from the upper edge of the rabbet of the keel to the......... Lower side of the lower cheek at the stem........................	28 2½	28 5	28 0	26 3	24 0	23 3	21 6	22 3	21 1	20 6	M
Upper side of the main rail at the stem..............................	41 0	38 0	36 0	34 0	32 0	30 3	28 0	28 9	27 3	26 3	N
Upper part of the knee at the fore part..........................	42 6	39 0	37 9	35 0	33 0	31 6	30 6	29 9	27 3	27 0	O
Scroll of the hair-bracket.........	47 0	45 0	40 6	38 3	35 9	34 6	32 9	31 10	30 6	29 0	P
Upper part of the scroll or figure head	51 4	48 0	44 0	42 0	41 0	36 3	35 0	33 9	32 3	30 9	Q
Knee.—Sided at the stem, at the upper side of upper cheek..	1 7½	1 6	1 5	1 4½	1 3½	1 3	1 2½	1 1½	1 1	1 0½	R
Sided at the fore part at the upper end...........	0 6	0 5½	0 5¼	0 5	0 5	0 5	0 4¾	0 4¾	0 4½	0 4¼	S
Cutting down above the upper side of the upper cheek..	1 0	0 11	0 10	0 10	0 9	0 9	0 9	0 9	0 9	0 7	T
Lacing to run up and support the figure, upper end.................................*sided*.........	1 4	1 3½	1 3	1 2½	1 2	1 1½	1 1	1 0½	1 0	1 0	U
Standard to be formed out of the knee, or a well grown standard...............*sided*.........	1 0	0 11	0 10	0 9½	0 9	0 9	0 9	0 8½	0 8½	0 8	X
Iron straps, two over ditto, with three bolts, *diameter*......	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	Y
Bolts in the Knee.—The two upper to be in diameter................ *in the knee*...	0 2¾	0 2⅝	0 2½	0 2⅜	0 2¼	0 2¼	0 2¼	0 2⅛	0 2⅛	0 2	Z
in the stem...	0 2⅝	0 2½	0 2⅜	0 2¼	0 2⅛	0 2⅛	0 2⅛	0 2	0 2	0 1⅞	A

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
A	*eight*	*eight*	*seven*	*six*	*seven*	*five*	*five*	...	*eight*	*eight*	*eight*	*eight*	*seven*	*seven*	*six*	*six*	*five*	
B	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	...	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	
C	0 1⅞	0 1⅞	0 1¾	0 1¾	0 1¾	0 1½	0 1½	...	0 2⅛	0 2⅛	0 2	0 2	0 1¾	0 1¾	0 1⅝	0 1½	0 1½	
D	*five*	*five*	*four*	*four*	*four*	*three*	*three*	...	*six*	*six*	*five*	*five*	*five*	*four*	*four*	*four*	*three*	
E	0 1	0 0⅞	0 0⅞	0 0¾	0 0⅞	0 0¾	0 0¾	...	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 0¾	
F	0 2	0 1⅞	0 1⅞	0 1½	0 1¾	0 1½	0 1½	...	0 2¼	0 2¼	0 2⅛	0 2	0 2	0 1⅞	0 1⅞	0 1½	0 1½	
G	0 1⅛	0 1⅛	0 1⅛	0 1	0 1⅛	0 1	0 1⅛	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1
H	0 2½	0 2½	0 2⅜	0 2	0 2¼	0 2	0 2	0 2	0 2½	0 2½	0 2½	0 2⅜	0 2⅜	0 2¼	0 2¼	0 2	0 2	0 2
I	9 0	8 9	9 0	7 6	8 0	5 6	6 0	...	12 6	12 2	12 0	10 6	8 1	9 3	5 2			
K	8 9	8 9	8 9	7 4	8 0	5 4	5 10	...	13 6	13 0	13 0	10 9	8 0	9 6	5 4			
L	2 5	2 4	...	1 7	2 2	1 5	1 5	...	3 6	3 6	3 0	2 3	2 1	1 10	*scroll*			
M	19 3	18 4	16 1	10 11	15 6	11 11	13 6	...	27 4	26 3	24 9	24 0	23 3	20 6	11 11			
N	25 3	23 3	20 6	14 3	19 3	13 9	17 3	...	35 6	34 3	32 9	28 9	28 0	25 6	14 8			
O	26 0	24 6	21 0	16 0	19 9	14 0	18 0	...	34 6	35 3	33 6	29 6	29 0	26 6	15 4			
P	28 0	26 6	...	16 5	22 9	18 5	20 9	...	39 6	38 0	36 9	32 4	31 6	29 3				
Q	29 9	28 0	23 6	18 4	23 9	18 9	21 0	...	42 6	41 0	39 3	34 0	33 0	30 6	17 3			
R	0 11½	0 11	0 10½	0 10	0 10½	0 10	0 11	...	1 3	1 3	1 2½	1 2	1 0	0 11	0 9½			
S	0 4	0 4	0 3¾	0 3	0 3½	0 3	0 3¼	...	0 4½	0 4½	0 4½	0 4¼	0 4	0 3¾	0 2¾			
T	0 7	0 7	0 6	0 4	0 6	0 4	0 5	...	1 0	1 0	0 11	0 10	0 8	0 6	0 4			
U	0 11	0 11	0 10	0 9	0 10	0 9	0 9	...	1 1	1 1	1 0	0 11	0 10	0 9	0 7			
X	0 8	0 7½	0 7	...	...	...	...	...	0 9	0 9	0 9	0 8	0 7	0 6½	0 6			
Y	0 0¾	0 0¾	0 0¾	...	...	...	...	...	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾			
Z	0 2	0 1⅞	0 1¾	0 1¼	0 1½	0 1¼	0 1¼	...	0 2¼	0 2⅛	0 2	0 1⅞	0 1¾	0 1⅝	0 1½	...	0 1¼	
A	0 1⅞	0 1¾	0 1⅝	0 1⅛	0 1⅜	0 1⅛	0 1⅛	...	0 2⅛	0 2	0 1⅞	0 1¾	0 1⅝	0 1½	0 1⅜	...	0 1¼	

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
HEAD—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
The third bolt in diameter......... *in the knee*	0 2½	0 2⅜	0 2¼	0 2⅛	0 2	0 2	0 2	0 1⅞	0 1⅞	0 1⅞	A
in the stem	0 2⅜	0 2¼	0 2⅛	0 2	0 1⅞	0 1⅞	0 1⅞	0 1¾	0 1¾	0 1	B
The fourth bolt in diameter........ *in the knee*	0 2¼	0 2⅛	0 2	0 1⅞	0 1¾	0 1¾	0 1¾	0 1¾	0 1¾	0 1⅝	C
in the stem	0 2⅛	0 2	0 1⅞	0 1¾	0 1⅝	0 1⅝	0 1	0 1⅝	0 1⅝	0 1½	D
The fifth bolt in diameter.......... *in the knee*	0 2⅛	0 2	0 1⅞	0 1¾	0 1⅝	0 1⅝	0 1⅝	0 1½	0 1½	0 1⅜	E
in the stem	0 2	0 1⅞	0 1¾	0 1⅝	0 1½	0 1½	0 1½	0 1⅜	0 1⅜	0 1¼	F
The lower bolts..........................*in diameter*	0 1¾	0 1⅝	0 1½	0 1½	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	G
CHEEKS—In number on each side..........................	*two or*	*three*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	H
Distance between the cheeks on a square at stem	3 9	3 0	2 10	2 6	2 3	2 2	1 9	1 9	1 9	1 8	I
Arms of the cheeks.............*length on the side*	13 0	12 6	12 0	11 9	11 6	9 6	8 6	8 6	8 6	8 6	K
length on the knee, at least	7 6	6 9	6 6	6 3	6 0	5 9	5 6	5 3	5 0	4 9	L
Lower cheek...............*sided at the after end*	1 2	1 1	1 0½	1 0	0 11	0 10	0 10	0 9½	0 9	0 8½	M
fore end	0 8	0 7½	0 7	0 7	0 6½	0 6	0 6	0 5¾	0 5½	0 5¼	N
moulded along the side	1 4	1 3	1 2	1 2	1 1	1 0	1 0	0 11½	0 11	0 10½	O
fore end	0 6	0 5½	0 5	0 5	0 4½	0 4	0 4	0 4	0 3¾	0 3¾	P
Upper cheek...............*sided at the after end*	1 1	1 0	0 11½	0 11	0 10	0 9½	0 9½	0 9	0 8½	0 8	Q
fore end	0 7	0 6½	0 6¼	0 6	0 5¾	0 5½	0 5¼	0 5	0 5	0 4¾	R
moulded along the side	1 3	1 2	1 1	1 1	1 0	0 11	0 11	0 10½	0 10	0 9½	S
at fore end...	0 5¾	0 5¼	0 4¾	0 4¾	0 4¼	0 3¾	0 3¾	0 3¾	0 3½	0 3½	T
Cheeks to be bolted each with bolts...*in number*	*thirteen*	*thirteen*	*twelve*	*twelve*	*twelve*	*eleven*	*eleven*	*ten*	*ten*	*ten*	U
diameter	0 1⅜	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	X
Iron cheeks, one pair, each to weigh.............	...	...	...	...	...	...	...	...	...	...	Y
Iron breasthook under the bowsprit to weigh....	...	...	...	...	...	...	...	...	...	...	Z
Bolted by bolts..........................*in number*	...	...	...	...	...	...	...	...	...	...	A
diameter	...	...	...	...	...	...	...	...	...	...	B
MAIN RAIL........................*moulded at the after end*	1 3	1 2	1 1	1 0	0 11½	0 11	0 10½	0 10	0 9½	0 8½	C
fore end	0 7½	0 7	0 6½	0 6	0 5¾	0 5½	0 5¼	0 5	0 5	0 4⅜	D
sided at the after end	1 0	0 11	0 10	0 9½	0 9	0 8¾	0 8½	0 7¾	0 7½	0 7	E
fore end	0 7	0 6⅝	0 6	0 5¾	0 5⅜	0 5¼	0 5⅛	0 4⅝	0 4½	0 4¼	F
Scarphs long..	1 8	1 8	1 8	1 8	1 6	1 6	1 6	1 6	1 6	1 4	G
Lining on the inside to succour the scarphs, *thick*	0 3½	0 3½	0 3½	0 3½	0 3	0 3	0 3	0 3	0 3	0 2½	H
Planksheer or lining upon the upperside ...*thick*	0 1½	0 1½	0 1½	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	I
Bolted at the after end with two or more bolts *diameter*	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	K
MIDDLE RAIL.....................*moulded at the after end*	0 9½	0 9	0 8½	0 8	0 7½	0 7	...	...	...	...	L
fore end	0 6	0 5	0 4¾	0 4⅜	0 4¼	0 4	...	...	...	...	M
sided at the after end	0 7	0 6½	0 6¼	0 6	0 5¾	0 5½	...	...	...	...	N
fore end	0 4¼	0 3⅞	0 3¾	0 3⅝	0 3½	0 3¼	...	...	...	...	O
LOWER RAIL.......................*moulded at the after end*	0 8¾	0 8¼	0 7¾	0 7¼	0 6¾	0 6½	0 6	0 5¾	0 5¼	0 5	P
fore end	0 4¾	0 4½	0 4¼	0 4⅛	0 4	0 3¾	0 3½	0 3½	0 3½	0 3¼	Q
sided at the after end	0 6	0 5¾	0 5½	0 5¼	0 5	0 5	0 4¾	0 4½	0 4½	0 4¼	R
fore end	0 3½	0 3⅜	0 3¼	0 3⅛	0 3	0 3	0 2⅞	0 2¾	0 2¾	0 2½	S
SUPPORTERS—To have a handsome supporter under each cathead.......................................*sided*	1 1	1 0	0 11	0 10	0 9½	0 9	0 8½	0 8	0 7½	0 7	T
The arm under the cathead in length, and the arm next the side as long as can be gotten....	5 0	4 10	4 9	4 9	4 7	4 6	4 4	4 4	4 2	4 0	U
Bolted through the cathead and side with bolts, in *number*	*nine*	*eight*	*eight*	*eight*	*eight*	*seven*	*seven*	*seven*	*seven*	*seven*	X
diameter	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	Y
HEAD TIMBERS—Number of timbers in the head	*four*	*four*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	Z
Stem timber, or *that next afore the stem, sided...*	0 8	0 7¾	0 7½	0 7¼	0 7	0 6¾	0 6½	0 6¼	0 6	0 5¾	A
the second sided	0 7	0 6¾	0 6	0 5¾	0 5½	0 5¼	0 5	0 4⅞	0 4⅝	0 4½	B
the third sided..	0 6	0 5¾	0 4½	0 4¼	0 4	0 3¾	0 3½	0 3½	0 3¼	0 3¼	C
the fourth sided	0 5	0 4¾									
Foremost head timber afore the stem............	9 0	8 9	8 6	8 0	7 0	5 6	6 3	6 0	5 6	5 3	D
Heels of them to be bolted together by bolts *diameter*	0 1	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	E
Rails to be fastened through the head timbers by bolts...................................*diameter*	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	F

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigan-tine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	0 1¾	0 1¾	0 1⅝	0 1⅛	0 1⅜	0 1⅛	0 1⅛	...	0 2⅛	0 1⅞	0 1¾	0 1⅝	0 1½	0 1⅜	0 1¼	...	0 1	
B	0 1⅝	0 1⅝	0 1½	0 1	0 1¼	0 1	0 1	...	0 2	0 1¾	0 1⅝	0 1½	0 1⅜	0 1¼	0 1⅛	...	0 1	
C	0 1⅝	0 1½	0 1⅜	0 1	0 1⅛	...	...	...	0 1¾	0 1½	0 1⅜	0 1¼	0 1¼	0 1⅛	0 1⅛			
D	0 1½	0 1⅜	0 1¼	0 1	0 1	...	...	...	0 1½	0 1⅜	0 1¼	0 1⅛	0 1⅛	0 1	0 1			
E	0 1⅜	0 1⅜	...	...	...	...	...	...	0 1⅜	0 1¼	0 1¼	0 1⅛	0 1⅛					
F	0 1¼	0 1¼	...	...	...	...	...	...	0 1¼	0 1¼	0 1¼	0 1	0 1					
G	0 1¼	0 1¼	0 1¼	0 0⅞	0 1	0 0⅞	0 0⅞	...	0 1¼	0 1¼	0 1¼	0 1	0 1	0 0⅞	0 0⅞			
H	*two*	*two*	*two*	*two*	*two*	*two*	*two*	...	*two or*	*three*	*two*	*two*	*two*	*two*	*two*			
I	1 7	1 6	1 2	1 0	1 0	1 0	1 4	...	2 6	2 4	2 3	1 4	1 6	1 8	0 9½			
K	8 0	7 6	7 0	5 6	6 9	6 0	6 3	...	10 6	10 0	8 0	6 9	6 9	6 6	6 0			
L	4 6	4 0	3 9	3 6	3 9	3 3	3 6	...	6 9	6 6	4 6	3 9	3 9	3 6	3 3			
M	0 8	0 7½	0 6½	0 6	0 6¼	0 6	0 6¼	...	0 10	0 9½	0 8½	0 8	0 7½	0 6½	0 5			
N	0 5	0 4¾	0 4	0 3½	0 3¾	0 3½	0 3¾	...	0 6	0 5¾	0 5¼	0 5	0 4¾	0 4	0 3			
O	0 10	0 9	0 8	0 6¾	0 7	0 6	0 6	...	1 0	0 11	0 10	0 10	0 9	0 8	0 6			
P	0 3½	0 3½	0 3¼	0 2¾	0 3	0 3	0 3	...	0 4½	0 4	0 4	0 3½	0 3¼	0 3	0 3			
Q	0 7½	0 7	0 6	0 5½	0 5¾	0 5½	0 5¾	...	0 10½	0 9½	0 8½	0 8½	0 8	0 7½	0 6			
R	0 4½	0 4¼	0 3½	0 3	0 3¼	0 3	0 3	...	0 5½	0 5¼	0 4¾	0 4½	0 4¼	0 3½	0 3			
S	0 9	0 8½	0 7½	0 7½	0 7½	0 7¼	0 7½	...	0 11½	0 10½	0 9½	0 9½	0 8½	0 7½	0 7			
T	0 3¼	0 3¼	0 3	0 2¾	0 3	0 3	0 3	...	0 4¼	0 3¾	0 3¾	0 3¼	0 3	0 3	0 3			
U	*nine*	*nine*	*eight*	*seven*	*eight*	*seven*	*seven*	...	*nine*	*nine*	*nine*	*nine*	*eight*	*eight*	*seven*			
X	0 1	0 1	0 0⅞	0 0¾	0 0⅞	0 0¾	0 0¾	...	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 0⅞	0 0⅞			
Y	...	...	...	...	...	...	...	...	4 1 0	4 0 0	3 3 0	3 1 0						
Z	...	...	...	...	...	...	...	...	7 0 0	7 0 0	7 0 0	6 2 0						
A	...	...	...	...	...	...	...	...	*ten*	*ten*	*ten*	*ten*						
B	...	...	...	...	...	...	...	...	0 1¼	0 1¼	0 1¼	0 1¼						
C	0 8	0 7½	0 7	0 6¾	0 7	0 6	0 6¼	...	0 9	0 9	0 8½	0 8	0 7	0 6½	0 6			
D	0 4½	0 4¼	0 4	0 3¾	0 4	0 3½	0 3¾	...	0 5	0 4¾	0 4½	0 4¼	0 4¼	0 3¾	0 3			
E	0 6½	0 6	0 5½	0 5	0 5¼	0 5	0 5	...	0 7	0 7	0 6½	0 6	0 5½	0 5	0 4			
F	0 3⅞	0 3⅝	0 3⅛	0 2¾	0 3	0 3	0 3	...	0 3½	0 3¼	0 3	0 3¼	0 3	0 2¾	0 2			
G	1 4	1 4	1 3	1 2	1 3	1 2	1 2	...	1 8	1 8	1 6	1 6	1 4	1 2	1 2			
H	0 2½	0 2½	0 2¼	0 1½	0 2	0 1½	0 1¾	...	0 3	0 3	0 3	0 2½	0 2	0 1½	0 1½			
I	0 1¼	0 1	0 1	0 0¾	0 1	0 0¾	0 0¾	...	0 1½	0 1½	0 1½	0 1¼	0 1¼	0 1	0 0¾			
K	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0⅞	0 0¾	0 0¾	...	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 0⅞	0 0¾			
L	...	...	...	...	...	...	...	...	0 7	0 6¾								
M	...	...	...	...	...	...	...	...	0 4	0 3¾								
N	...	...	...	...	...	...	...	...	0 5½	0 5¼								
O	...	...	...	...	...	...	...	...	0 3¼	0 3								
P	0 4½	0 4¼	0 4	0 3¾	0 3¾	0 3½	0 3¾	...	0 6¼	0 6	0 6	0 5½	0 5	0 4¼	0 3			
Q	0 3¼	0 3	0 2¾	0 2¼	0 2½	0 2¼	0 2½	...	0 3½	0 3¼	0 3½	0 3¼	0 3¼	0 2¾	0 2			
R	0 4	0 3¾	0 3½	0 3	0 3¼	0 3	0 3¼	...	0 5	0 4¾	0 4¾	0 4½	0 4	0 3¼	0 3			
S	0 2⅜	0 2¼	0 2⅛	0 1¾	0 2	0 1¾	0 2	...	0 3	0 3	0 2¾	0 2½	0 2¼	0 2	0 2			
T	0 6½	0 6	0 5½	0 4½	0 5	0 4½	0 4¾	...	0 9	0 8	0 7½	0 6½	0 6	0 5½	0 5			
U	4 0	3 10	3 9	3 6	3 9	3 0	3 2	...	4 3	4 0	4 0	3 9	3 7	3 6	3 3			
X	*seven*	*seven*	*six*	*six*	*six*	*five*	*five*	...	*seven*	*seven*	*seven*	*seven*	*six*	*six*	*five*			
Y	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0⅞	0 0¾	0 0¾	...	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞			
Z	*three*	*three*	*three*	*three*	*three*	*two*	*two*	...	*three*	*three*	*three*	*three*	*three*	*three*	*three*			
A	0 5½	0 5¼	0 4½	0 4	0 4½	0 3	0 3¼	...	0 6½	0 6	0 5½	0 5¼	0 5	0 4¼	0 4			
B	0 4⅜	0 4⅛	0 3½	0 3	0 2½	0 2½	0 2¾	...	0 5	0 4⅝	0 4⅜	0 4¼	0 4	0 3¼	0 3			
C	0 3¼	0 3	0 2½	0 2	0 2½	0 2	0 2¼	...	0 3½	0 3¼	0 3¼	0 3	0 3	0 2¼	0 2			
D	5 0	4 9	5 7	4 6	4 0	2 9	3 6	...	7 0	6 6	6 3	6 0	5 6	5 3	2 3			
E	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	0 0⅝	0 0⅝	...	0 1	0 1	0 0⅞	0 0¾	0 0¾	0 0¾	0 0⅝			
F	0 0¾	0 0¾	0 0⅝	0 0½	0 0¾	0 0⅝	0 0⅝	...	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅝			

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks. GUNS 110	GUNS 98	Of Two Decks. GUNS 80	GUNS 74	GUNS 64	GUNS 50	Frigates. GUNS 44	GUNS 38	GUNS 36	GUNS 32	
HEAD—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Iron knee strap bolted abaft the second timber.......*diameter*......	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	A
BEAM.—Athwart the head.......*to round up*......	0 3	0 3	0 2¾	0 2½	0 2½	0 2¼	0 2	0 2	0 2	0 2	B
sided......	1 1	1 0½	1 0	1 0	0 11½	0 11	0 10½	0 10	0 9½	0 9	C
deep......	0 11	0 10½	0 10	0 10	0 9½	0 9	0 8½	0 8	0 7½	0 7	D
KNEE.—One at each end of the aft side of the beam, *sided*......	0 7	0 6¾	0 6½	0 6¼	0 6	0 5¾	0 5½	0 5¼	0 5	0 4¾	E
arms long......	3 0	3 0	2 10	2 10	2 9	2 9	2 8	2 7	2 6	2 5	F
Bolts in each arm.......*number*......	*three*	*three*	*three*	*three*	*three*	*three*	*two*	*two*	*two*	*two*	G
diameter......	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	H
To have one or two bolts driven through the middle into the stem.......*diameter*......	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	I
CROSS PIECES.—To have one or two cross-pieces foremost.......*sided*......	0 5	0 4¾	0 4½	0 4¼	0 4	0 3¾	0 3½	0 3	0 3	0 3¾	K
After.......*sided*......	0 6	0 5¾	0 5½	0 5¼	0 5	0 4¾	0 4½	0 4¼	0 4	...	L
FALSE RAIL.—The false rail to be sided	0 7	0 6¾	0 6½	0 6¼	0 6	0 5¾	0 5½	0 5¼	0 5	0 4¾	M
Bolted to the main rail with bolts, *diameter*......	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	N
CARLINGS.—To have a fore and aft carling on each side of the gammoning...... { *sided*......	0 6	0 5½	0 5½	0 5¼	0 5	0 5	0 4½	0 4½	0 4¼	0 4	O
{ *deep*......	0 8	0 7	0 7	0 6½	0 6	0 6	0 5½	0 5½	0 5½	0 5	P
LEDGES.—The flat of the head to be framed with ledges.......*broad*......	0 3	0 3	0 3	0 3	0 3	0 3	0 2½	0 2½	0 2½	0 2½	Q
deep......	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	0 2	0 2	0 2	0 2	R
BOOMKINS.—One on each side, length sufficient to plumb with the outer end of the fore yard when braced sharp.											
To taper to ¾ of these..... Dimensions at the outer end { *sided* } fir, if oak, three inches less...	1 4	1 3½	1 3¼	1 3	1 2½	1 2	1 2	1 1½	1 1	1 0½	S
{ *deep* }	1 5	1 4½	1 4¼	1 4	1 3½	1 3	1 3	1 2½	1 2	1 1½	T
To be bolted through the beam and chock, with a bolt.......*diameter*......	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	U
To have iron stays.......*diameter*......	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	X
SEATS of EASE, &c. as directed.											
IRON HORSES.......*diameter*......	0 2¼	0 2¼	0 2⅛	0 2⅛	0 2	0 2	0 2	0 2	0 2	0 2	Y
Stantions to ditto.......*diameter*......	0 1¾	0 1¾	0 1⅝	0 1⅝	0 1½	0 1½	0 1½	0 1½	0 1½	0 1½	Z
Bolts with eyes to ship in the horses, *diameter*...	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	A
FILLINGS between the CHEEKS, WASH CANTS or WASH BOARDS under the Cheeks, as directed.											
BOLSTERS or NAVAL HOODS under the HAWSE HOLES. { To come up the holes at least two-thirds of their depth. To project the cheeks......	0 2	0 2	0 1¾	0 1¾	0 1½	0 1½	0 1¼	0 1¼	0 1¼	0 1⅛	B
Bolted with bolts.......*in number*......	*eight*	*eight*	*eight*	*eight*	*six*	*six*	*six*	*six*	*six*	*six*	C
diameter......	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	D
GAMMONING HOLES.......*number*......	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	E
length......	1 4	1 4	1 3	1 3	1 3	1 2	1 2	1 2	1 2	1 1	F
depth......	0 3½	0 3½	0 3	0 3	0 2¾	0 2½	0 2¼	0 2¼	0 2¼	0 2	G
BOBSTAY HOLES.......*number*......	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	H
diameter......	0 5	0 5	0 4¾	0 4¾	0 4½	0 4½	0 4¼	0 4¼	0 4¼	0 4	I
EYE-BOLTS for BOBSTAY, one on each side, through knighthead, in lower piece of wale...... { *diameter*......	0 2⅛	0 2⅛	0 2	0 2	0 2	0 1¾	0 1¾	0 1¾	0 1¾	0 1⅝	K
{ *eyes in the clear*	0 3	0 3	0 3	0 3	0 3	0 2¾	0 2¾	0 2¾	0 2¾	0 2⅝	L
Triangle ring-bolts in the side of knee for boomkin lashings { *diameter*......	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 0⅞	M
{ *rings in the clear*	0 7	0 7	0 6	0 6	0 5½	0 5	0 5	0 5	0 5	0 4¾	N
GRIPE may be elm, sided the same as the knee, and moulded in the broadest place......	4 5	4 5	4 10	3 9	3 6	3 4	3 0	3 2	3 2	3 0	O
Bolted with bolts.......*diameter*......	0 1½	0 1½	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	P
And further secured with copper horse shoes, *thick*......	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	Q
broad......	0 5	0 5	0 4¾	0 4¾	0 4½	0 4½	0 4¼	0 4	0 4	0 4	R
Bolted through with bolts.......*in diameter*......	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	S
number......	*six*	*six*	*six*	*six*	*six*	*six*	*five*	*five*	*five*	*five*	T

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	0 0¾	0 0¾	0 0⅝	...	...	...	...	...	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾					
B	0 1¾	0 1¾	0 1½	0 1¼	0 1½	0 1	0 1	...	0 2¼	0 2	0 2	0 2	0 1¾	0 1½	0 1			
C	0 8	0 8	0 7½	0 7	0 7½	0 6	0 6½	...	0 11	0 10	0 9½	0 9	0 8	0 7	0 6			
D	0 6½	0 6	0 5½	0 5	0 5½	0 4½	0 5	...	0 9	0 8	0 7½	0 7	0 6	0 5¾	0 5			
E	0 4½	0 4¼	0 4	0 3½	0 3¾	0 3	0 3¼	...	0 6	0 5½	0 5	0 4½	0 4¼	0 4	0 3			
F	2 4	2 4	2 3	2 0	2 2	1 9	1 10	...	2 9	2 9	2 7	2 5	2 3	2 0	1 10			
G	*two*	*two*	*two*	*two*	*two*	*two*	*two*	...	*three*	*three*	*two*	*two*	*two*	*two*	*two*			
H	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	0 0⅝	0 0⅝	...	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅝			
I	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0⅞	0 0¾	0 0¾	...	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾			
K	0 3½	0 3¼	0 3	0 2¾	0 3	0 2½	0 2½	...	0 4	0 3¾	0 3	0 4	0 3¾	0 3½	0 3			
L	...	...	...	...	...	...	...	...	0 5	0 4¾	0 4¼							
M	0 4½	0 4¼	0 4	0 3½	...	...	...	...	0 5	0 5	0 5	0 4¾	0 4½	0 4	0 3½			
N	0 0¾	0 0¾	0 0¾	0 0⅝	...	...	...	...	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾			
O	0 3½	0 3½	0 3	0 2¼	0 3	0 3	0 3	...	0 4½	0 4½	0 4½	0 4¼	0 4	0 4	0 3½			
P	0 4¾	0 4½	0 4	0 3½	0 4	0 3¾	0 3¾	...	0 5¼	0 5¼	0 5	0 4¾	0 4½	0 4½	0 4			
Q	0 2½	0 2½	0 2½	0 2	0 2½	0 2	0 2	...	0 3	0 3	0 3	0 2½	0 2½	0 2½	0 2½			
R	0 2	0 2	0 2	0 1¾	0 2	0 1¾	0 1¾	...	0 2½	0 2½	0 2½	0 2	0 2¼	0 2	0 2			
S	1 0	0 11½	0 11	0 8	0 10	0 8	0 8½	...	1 2	1 1½	1 1	1 0	0 10	0 9	0 6			
T	1 1	1 0½	1 0	0 9	0 11	0 9	0 9½	...	1 3	1 2½	1 1½	1 1	0 11	0 10	0 7			
U	0 1	0 1	0 1	0 0¾	0 0⅞	0 0¾	0 0¾	...	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 0⅞			
X	0 1	0 1	0 0⅞	0 0¾	0 0¾	0 0⅞	0 0⅞	...	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 1	0 1			
Y	0 1⅞	0 1¾	0 1¾	0 1½	0 1¾	0 1¼	0 1¼	...	0 1⅞	0 1⅞	0 1¾	0 1⅝	0 1½	0 1½				
Z	[illegible]	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	...	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼				
A	0 [illegible]	0 1⅛	0 1⅛	0 1	0 1[illegible]	0 1	0 1	...	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1				
B	0 1⅛	0 1	0 1	0 0¾	0 0⅞	0 0¾	0 0¾	0 0¾	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 1	0 0¾	0 0¾	0 0¾	0 0¾
C	*six*	*six*	*six*	*four*	*six*	*four*	*four*	*four*	*six*	*six*	*six*	*six*	*six*	*six*	*four*	*four*	*four*	*four*
D	0 1	0 1	0 0⅞	0 0¾	0 0⅞	0 0¾	0 0¾	0 0¾	0 1⅛	0 1⅛	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾
E	*two*	*one*	*one*	*one*	*one*	*one*	*one*	...	*two*	*two*	*two*	*one*	*one*	*one*	*one*	*one*		
F	1 1	1 1	1 0	0 11	1 1	0 11	0 11	...	1 3	1 3	1 2	1 2	1 1	1 0	1 0	0 11		
G	0 2	0 2	0 1¾	0 1¼	0 1½	0 1¼	0 1¼	...	0 2¼	0 2¼	0 2	0 2	0 1¾	0 1½	0 1½	0 1¼		
H	*two*	*two*	*two*	*one*	*two*	*one*	*one*	...	*three*	*three*	*two*	*two*	*two*	*two*	*one*	*one*		
I	0 3¾	0 3½	0 3¼	0 2½	0 2¾	0 2½	0 2½	...	0 4	0 4	0 3¾	0 3½	0 3¼	0 3	0 3	0 2½		
K	0 1⅝	0 1½	0 1½	...	0 1⅜													
L	0 2⅝	0 2½	0 2½	...	0 2⅜													
M	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	...	...	...	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾		
N	0 4½	0 4½	0 4	0 3¾	0 4	...	...	...	0 5	0 5	0 5	0 4¾	0 4½	0 4	0 4	0 3¾		
O	2 9	2 8	2 6	2 0	2 3	2 1	2 9	2 0	3 9	3 6	3 3	3 0	2 10	2 8	2 6	1 3	1 9	1 2
P	0 1⅛	0 1⅛	0 1⅛	0 0⅞	0 1	0 0¾	0 0⅞	0 0¾	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 0⅞	0 0¾
Q	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾			
R	0 3½	0 3½	0 3¼	0 3	0 3¼	0 3	0 3	0 3	0 4	0 4	0 4	0 3½	0 3½	0 3¼	0 3			
S	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾			
T	*five*	*five*	*five*	*five*	*five*	*five*	*five*	*five*	*six*	*six*	*six*	*five*	*five*	*five*	*five*			

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.				Of Two Decks.								Frigates.								
	GUNS 110		GUNS 98		GUNS 80		GUNS 74		GUNS 64		GUNS 50		GUNS 44		GUNS 38		GUNS 36		GUNS 32		
HEAD—*continued.*	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	ft.	in.	
Gripe and front of the knee to be lined with thick lead, 12lbs. to the foot square.																					
To run abaft the foremost end of the keel.......	12	0	12	0	10	0	10	0	10	0	10	0	9	0	9	0	9	0	8	0	A
To run up to the top of the knee within........	6	0	6	0	5	0	5	0	5	0	5	0	4	0	4	0	4	0	3	6	B
And to lap on each side..........................	0	8	0	8	0	7	0	7	0	7	0	7	0	6	0	6	0	6	0	5	C
STERN.																					
HEIGHT from the upper-side of the rabbet of the keel, to the......... Touch of the lower counter at middle line..........	35	2	33	5	33	6	30	9	30	6	28	8	26	1	26	1	25	9	24	6	D
Touch of the upper counter at middle line..........	38	1	36	7	36	3	34	3	33	0	31	3	28	6	27	11	28	0	26	6	E
Upper part of lower balcony breastrail...	46	9	44	8	46	0	42	6	42	0	39	9	...		...		...		...		F
Or ditto above the plank of the deck....	3	6	3	4	3	6	3	4	3	4	3	2	...		...		...		...		G
Upper part of upper balcony breastrail.........	53	9	51	8																	
Or ditto above the plank of the deck...........	3	2	3	2																	
Upper part of the taffarel.......................	62	0	58	3	53	4	50	6	50	0	47	0	37	2	36	9	36	4	34	6	H
BREADTH of the Stern at the height of the top timber line	25	0	23	0	25	6	25	0	22	0	19	6	24	0	22	0	20	9	18	9	I
LENGTH taken from the after perpendicular to the Touch of the lower counter at middle line	8	4½	6	6	7	9	7	0	7	6	5	8	6	0	6	0	6	0	5	9	K
Touch of upper counter at middle line	9	10	8	0	10	0	9	0	9	6	7	4½	7	6	7	10	7	6	7	0	L
Counter timber at the height of the taffarel at middle line....................	15	0½	13	0	15	6	13	4	14	0	11	5	10	4	10	7	10	3	10	0	M
ROUND UP of the lower counter........... *upon a level*	0	11	0	10	0	9	0	9	0	7	0	6	0	7	0	5	0	7	0	7	N
Round aft of the lower counter.. *upon a level*	1	2	1	3	1	3	1	3	1	2	1	1	1	2	1	1	1	0	1	0	O
Lower counter rail.......................... *thick*	0	8	0	7½	0	7	0	7	0	6½	0	6	0	5	0	4½	0	4½	0	4¼	P
broad	0	11	0	8½	0	8	0	8	0	7½	0	7	0	6	0	6	0	6	0	5½	Q
Hollow of the lower counter......................	0	9	0	7	0	6	0	6	0	6	0	6	0	5	0	5	0	4	0	4	R
Round up of the upper counter.. *upon a level*	1	1	1	0	0	11	0	11	0	8	0	7	0	8	0	8	0	8	0	8	S
Round aft of the upper counter. *upon a level*	1	4	1	3	1	3	1	3	1	1	0	11	1	2	1	1	1	1	1	0	T
Upper counter rail...................... *thick*...	0	8	0	7½	0	7	0	7	0	6½	0	6½	0	5½	0	5½	0	5½	0	5	U
broad	0	10	0	8½	0	8	0	8	0	7½	0	7	0	6½	0	6	0	6	0	5½	X
Hollow of the upper counter......................	0	2	0	2	0	1½	0	1½	0	1½	0	2	0	1	0	1	0	1	0	1	Y
Length of the lower gallery rim from the aft part of the side counter timber	15	6	13	0	15	6	13	0	12	0	12	0	11	6	11	6	11	0	10	0	Z
Length of the middle gallery rim from ditto...	13	6	10	6																	
Length of the upper gallery rim from ditto ...	12	0	8	0	13	6	10	3	9	6	9	3	...		...		...		...		A
Lower gallery lights in length on the rake......	3	9	3	6	4	0	3	6	3	6	3	6	3	4	3	3	3	0	2	9	B
breadth on a square	2	9	2	10	2	10	2	10	2	8	2	3	2	0	2	1	1	10	1	10	C
Middle gallery lights in length on the rake.....	3	4	3	4																	
breadth on a square	2	5	2	1																	
Upper gallery lights in length on the rake......	3	4	2	10	3	2	3	2	3	2	2	9	...		...		...		...		D
breadth on a square	2	0	1	8	2	6	2	5	2	4	1	9	...		...		...		...		E
Projection of the balconies from the side counter timber at the middle line................	3	6	3	5	4	0	3	3	2	6	3	3	...		...		...		...		F
Depth of the taffarel..............................	5	4	2	9	3	5	3	4	3	3	3	11	3	0	3	1	2	4	2	9	G
Siding of the quarter pieces........................	1	9	1	8	1	7	1	6	1	5	1	4	0	11	0	11	0	11	0	10½	H
COUNTER TIMBERS—To have side counter timbers sided full the scantling of the frame, the after frame or two to be left full for that purpose.																					
heel......	2	0	1	11	1	10	1	10	1	7	1	7	1	6	1	6	1	6	1	5	I
Moulded on a square at the..... *lower counter*	2	10	1	9	1	8	1	8	1	7	1	7	1	6	1	6	1	6	1	5	K
head	1	2	1	1	1	1	1	1	1	0	1	0	0	11	0	11	0	11	0	10	L
Two or three bolts through the heel of the after frame and head of the fashion piece *diameter*	0	1¼	0	1¼	0	1⅛	0	1⅛	0	1⅛	0	1	0	1	0	1	0	1	0	0⅞	M
To have right after counter timbers to form the stern lights and counter ports ....*number*	*six*		*six*		*six*		*six*		*six*		*six*		*six*		*six*		*six*		*six*		N
sided at the heels	1	1	1	0	0	11½	0	11	0	10	0	9½	0	9½	0	9	0	9	0	8½	O
........*heads*...	0	7½	0	7	0	6½	0	6¼	0	5½	0	5½	0	5¼	0	5¼	0	5	0	4¾	P
Moulded on a square at the.......... *heels*	1	2	1	2	1	1	1	1	0	11	0	11	0	11	0	10	0	10	0	9	Q
heads ...	0	9	0	8½	0	8	0	8	0	7	0	6½	0	6	0	6	0	5½	0	5½	R
The heels of the counter timbers to face down on the foreside................................	0	1½	0	1½	0	1⅜	0	1⅜	0	1¼	0	1¼	0	1¼	0	1¼	0	1¼	0	1⅛	S

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in*	*ft. in*	*ft in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	8 0	6 0	6 0	5 0	6 0	5 0	5 0	5 0	10 0	10 0	9 0	8 0	6 0	6 0	6 0	5 6		
B	3 6	3 6	3 6	2 9	3 0	2 9	2 9	2 9	5 0	5 0	4 6	3 6	3 0	3 0	2 9	2 0		
C	0 5	0 5	0 4½	0 4	0 4½	0 4	0 4	0 4	0 6	0 6	0 6	0 6	0 5	0 5	0 4½	0 4		
D	22 9	22 0	19 0	14 3	20 3	17 6	23 3	17 0	29 6	28 0	27 0	26 3	23 4	22 6	16 10	14 0	16 0	11 1
E	24 9	24 0	20 3	15 2	...	19 11	27 3	20 3	31 9	30 0	29 0	28 3	25 4	24 3	20 1½	...	17 2	
F	...	...	...	...	...	...	...	...	39 6	37 6	36 0							
G	...	...	...	...	...	...	...	...	3 0	2 10	2 10							
H	32 9	32 0	27 3	21 2	23 6	21 2	27 3	20 3	46 3	45 0	44 0	37 0	33 0	31 9	21 8	16 9	22 6	14 6
I	18 6	17 0	13 6	14 0	5 8	13 0	15 0	10 9	24 0	21 6	20 0	19 0	16 8	15 0	13 4	8 3	15 8	10 0
K	5 3	5 1	4 0	3 1	4 10	5 0	5 6	6 0	4 1	4 0	3 9	3 10	3 9	3 4	4 3½	3 10	2 4	0 6
L	6 4	6 6	5 1	3 11	...	6 0	...	7 6	5 3	5 2	5 2	5 2	5 0	4 5	...	...	3 2	
M	8 9	9 0	7 6	6 5	...	6 8	6 9	...	11 6	11 3	11 0	8 0	8 6	7 0	6 2	5 2	4 10	1 11
N	0 6	0 6	0 6	0 4	0 4	0 5	0 6	0 6	0 8	0 7	0 6	0 5	0 5	0 5	0 6	0 6	0 5	0 4
O	0 11	0 9	0 8¾	0 9	0 9	0 10	0 11	0 11	1 1	1 0	0 10	0 8	0 8	0 9	0 7	0 9	0 9	0 5
P	0 4	0 3½	0 3½	0 3	0 3	0 3¼	0 3½	0 3¼	0 6	0 6	0 5½	0 5	0 5	0 5	0 3	0 2	0 3	0 2½
Q	0 5	0 5	0 4½	0 4	0 3½	0 4	0 4½	0 4	0 7	0 7	0 6½	0 6	0 6	0 6	0 4	0 3¾	0 4	0 3
R	0 4	0 4	0 3	0 3	0 4	0 6	0 6	0 5	0 5	0 4	0 4	0 3	0 3	0 5	0 6	0 3	0 2	0 2
S	0 7	0 7	0 7	0 4	...	...	...	...	0 9	0 8	0 7	0 6	0 6	0 7	1 0	...	0 6	
T	0 11	0 10	0 8	0 8	...	...	...	...	1 1	1 0	1 0	0 10	0 10	1 1	0 7	...	0 9	
U	0 4½	0 4	0 3¾	0 3¼	...	...	...	...	0 6	0 6	0 5½	0 5	0 5	0 5	0 3	...	0 3	
X	0 5	0 5	0 4½	0 4	...	...	...	...	0 7	0 7	0 6½	0 6	0 6	0 6	0 3¾	...	0 3¾	
Y	0 0¾	0 0¾	0 0¾	0 1	...	...	...	...	0 2	0 2	0 1¾	0 1½	0 1	0 1	...	...	0 1	
Z	9 6	9 6	8 0	...	...	...	...	...	13 0	12 0	11 6	10 6	10 6	10 6				
A	...	...	...	...	...	...	...	...	11 6	10 6	9 6							
B	2 8	2 8	2 8	...	...	...	...	...	3 2	3 2	3 0	2 10	2 10	2 10				
C	1 10	1 10	1 10	...	...	...	...	...	2 4	2 2	2 0	1 10	1 9	1 8				
D	...	...	...	...	...	...	...	...	2 10	2 10	2 9							
E	...	...	...	...	...	...	...	...	2 0	1 10	1 8							
F	...	...	...	...	...	...	...	...	3 0	3 0	2 9							
G	2 8	2 7	2 0	1 11	...	...	...	...	3 6	3 4	3 2	3 6	3 3	2 10	2 4			
H	0 10	0 10	0 9	0 10	0 8	0 9	0 10	0 10	1 2	1 1	1 0	0 11	0 11	0 10	0 10	...	0 8	
I	1 4	1 2	0 10	0 9	...	0 9	0 10	0 9	1 6	1 6	1 5	1 4	1 0	1 0	0 8½	0 8	0 9	0 7
K	1 4	1 2	...	0 9	...	0 11	1 0	0 11	1 4	1 4	1 3	1 2	1 0	1 0	0 8½	0 8	0 9	0 7
L	0 10	0 10	0 9	0 8	...	0 8	0 9	0 9	0 11	0 11	0 11	0 10	0 10	0 9	0 8	0 6	0 6	0 5
M	0 0⅞	0 0⅞	0 0⅞	0 0⅞	...	0 0⅞	0 0⅞	0 0⅞	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾
N	*four*	*four*	*four*	*four*	...	*four*	*four*	*four*	*six*	*five*	*five*	*five*	*four*	*four*	*four*	*four*	*four*	*four*
O	0 8	0 7½	0 7	0 5½	...	0 5½	0 6	0 5¾	0 10	0 9	0 9	0 7	0 7	0 6½	0 6	0 5¾	0 6	0 5
P	0 4½	0 4¼	0 4	0 3	...	0 3½	0 3¾	0 3¾	0 6	0 6	0 6	0 5	0 5	0 4	0 3½	0 3	0 4	0 3½
Q	0 9	0 9	0 8	0 7	...	0 6	0 7	0 6	0 11	0 10	0 10	0 9	0 8	0 7	0 6½	0 6	0 7	0 5½
R	0 5	0 5	0 4½	0 3½	...	0 4	0 4½	0 4¼	0 7	0 6½	0 6	0 6	0 6	0 5	0 4½	0 4	0 5	0 4
S	0 1⅛	0 1	0 1	0 0⅞	...	0 0¾	0 0¾	0 0¾	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 1	0 0⅞	0 0¾	0 0¾

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	—
STERN—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
And bolted through the transom with one bolt ... *diameter* ...	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 0⅞	A
And further secured by iron strap to each, *thick* ...	0 1⅛	0 1⅛	0 1	0 1	0 1	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	B
broad ...	0 5	0 5	0 5	0 5	0 4½	0 4½	0 4½	0 4	0 4	0 4	C
Bolts in the straps, six; in the timber, three; and in the transoms, three ... *diameter* ...	0 1⅛	0 1⅛	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	D
Intermediate counter-timbers, *number* (or as seem necessary) ...	*six*	*six*	*four*	*four*	*four*	*four*	*four*	*four*	*two*	*two*	E
COUNTER PORTS.—To have one on each side in the lower counter ... *deep* ...	2 6	2 4	2 4	2 4	2 3	2 2	2 0	1 10	1 10	1 8	F
(Hung with lids as gun-deck.) ... *thwartships* ...	2 8	2 6	2 6	2 6	2 5	2 9	2 4	2 2	2 0	1 10	G
Birthing up of lower counter plank, *thick* ...	0 4	0 4	0 3½	0 3½	0 3½	0 3	0 3	0 3	0 3	0 3	H
UPPER COUNTER.—Number of ports on each side ...	*two*	*two*	*one*	*one*	*one*	*one*	*one*	*one*	*one*	*one*	I
Birthing up of the second counter, to be of oak plank, rabbetted ...	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	0 2	0 2	0 2	0 2	K
thwartships ...	2 8	2 4	2 2	2 2	2 2	2 2	Of the size of the lights.				
N. B. *Ring and eye bolts of the counter ports the size of those at the ports of the respective decks.*											
Lower dead lights, oak plank ... *thick* ...	0 2	0 2	0 2	0 2	0 2	0 2	...	...	...	...	L
Linings, elm board ... *thick* ...	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	...	...	...	...	M
Upper dead lights made of deal, rabbetted, *thick* ...	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	N
Linings deal ... *thick* ...	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	O
RUDDER.											
The head to be long enough to receive a tiller above deck ... *deck* ...	*middle*	*middle*	*upper*	*upper*	*upper*	*upper*	*upper*	*upper*	*upper*	*upper*	P
*** *The head to be left as large as the main piece will convert.* { Head to be athwartships	2 4	2 3	2 3	2 2	2 1	1 11	1 9	1 8	1 8	1 7	Q
fore and aft ...	2 6	2 5	2 5	2 4	2 3	2 1	2 0	1 10	1 10	1 8	R
Lower hance ... *fore and aft* ... { *Back included.*	5 0	4 7	4 6	4 3	4 0	3 9	3 7	3 6	3 4	3 2	S
Heel ... *fore and aft* ...	6 6	6 3	6 1	5 10	5 6	5 3	5 0	4 9	4 7	4 4	T
Thickness or siding, agreeable to the stern post.											
Thickness of the back ...	0 4	0 4	0 3½	0 3½	0 3	0 3	0 3	0 3	0 3	0 3	U
Thickness of the sole ...	0 6	0 6	0 6	0 6	0 6	0 6	0 5	0 5	0 5	0 5	X
The rudder to be short of the underside of the keel at the { *fore end* ...	0 9	0 9	0 9	0 9	0 9	0 9	0 9	0 9	0 9	0 9	Y
after end ...	0 11	0 11	0 11	0 11	0 11	0 11	0 11	0 11	0 11	0 11	Z
Bolted together with bolts ... *in number* ...	*seven*	*seven*	*seven*	*seven*	*six*	*six*	*six*	*six*	*six*	*five*	A
diameter ..	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	B
The head of the rudder to be secured with { Iron hoops, *in number* ...	*five*	*five*	*five*	*five*	*five*	*five*	*five*	*five*	*five*	*five*	C
broad ...	0 5	0 5	0 4½	0 4½	0 4	0 4	0 4	0 4	0 4	0 3½	D
thick ...	0 0¾	0 0¾	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0⅝	E
To have holes between the hoops for the tiller, *number* ...	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	F
thwartships ...	0 11¾	0 11½	0 10¾	0 10¾	0 10½	0 10½	0 10½	0 10½	0 10½	0 10¼	G
deep ...	0 11¾	0 11½	0 10¾	0 10¾	0 10½	0 10½	0 10½	0 10½	0 10½	0 10¼	H
(To have a norman and chocks provided for steadying the rudder head.)											
Braces and pintles for hanging the rudder } *Number of pairs* ...	*seven*	*seven*	*seven*	*seven*	*six*	*six*	*six*	*six*	*six*	*five*	I
The upper brace may	be iron, and the straps sufficiently long to turn and meet round the head of										K
The second brace in length from the rabbet of the post ...	5 4	5 0	4 10	4 8	4 3	4 0	4 0	4 0	3 9	3 6	L
The lower brace in length from the rabbet of the post ...	8 0	7 6	7 3	7 0	6 9	6 6	6 6	6 6	6 0	5 9	M
PINTLES.—The upper pintle may be iron, and the straps	long enough to turn and meet on the aftside of the rudder, and the straps of										N
Straps of the braces and pintles broad ...	0 5½	0 5¼	0 5	0 4¾	0 4½	0 4¼	0 4	0 4	0 4	0 3¾	O
Thickness in the shoulder at the return ...	0 2⅛	0 2	0 1⅞	0 1⅞	0 1¾	0 1¾	0 1⅝	0 1⅝	0 1½	0 1½	P

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	0 0⅞	0 0⅞	0 0¾	0 0⅝	...	0 0¾	0 0¼	0 0¾	0 1⅛	0 1⅛	0 1	0 1	0 0⅞	0 0¼	0 0¾	0 0⅝		
B	0 0¾	0 0¾	0 0⅝	...	...	...	...	...	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾					
C	0 3½	0 3½	0 3½	...	...	...	...	...	0 4½	0 4½	0 4½	0 4	0 4					
D	0 0¾	0 0¾	0 0¾	...	...	...	...	...	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾					
E	*two*	*two*	*two*	...	...	...	...	...	*four*	*four*	*four*	*two*	*two*					
F	1 6	1 4	...	0 11	1 6	...	...	...	2 0	2 0	1 10	1 8	1 6	1 4	1 2			
G	1 8	1 6	...	0 11	1 8	...	...	...	2 2	2 2	2 0	1 10	1 8	1 6	1 4			
H	0 3	0 3	...	0 2	0 3	0 2	0 2½	0 2½	0 4	0 4	0 4	0 3½	0 3	0 3	0 2½	0 2	0 2½	0 2
I	*one*	*one*	*one*															
K	0 2	0 2	0 2	0 1½	...	0 1½	0 1½	0 1½	0 2½	0 2½	0 2½	0 2	0 2	0 2	0 1½	0 1½		
L	...	...	...	...	...	...	...	...	0 2	0 2	0 2							
M	...	...	...	...	...	...	...	...	0 0¾	0 3¾	0 0¾							
N	0 1¼	0 1¼	0 1¼	0 1¼	...	...	...	...	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼			
O	0 0¾	0 0¾	0 0⅝	0 0⅝	...	...	...	...	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅝	0 0⅝			
P	*upper*	*upper*	*quarter deck*	*poop*	*quarter deck*	*main deck*			*middle*	*middle*	*middle*	*upper*	*middle*	*upper*	*upper or main deck.*			
Q	1 6	1 5	1 3	0 11	1 2	1 1	1 1	1 1 } *round headed*	2 3	2 2	2 2	1 10	1 6	1 5 }	1 1	0 8	0 10½	0 9
R	1 7	1 6	1 4	1 0	1 3	1 2	1 3	1 3	2 3	2 2	2 2	1 10	1 6	1 5	1 4	0 9	0 11½	0 10
S	3 0	2 10	2 8	1 10	2 6	2 3	2 9	2 4	3 9	3 6	3 4	3 0	2 9	2 8	2 6	1 9	2 0	1 2
T	4 2	4 0	4 3	2 10	4 3	3 4	3 9	3 6	5 9	5 4	5 0	4 6	4 3	4 0	3 6	2 9	3 0	2 0
U	0 3	0 2½	0 2½	0 2	0 2½	0 2	0 3	0 2½	0 3	0 3	0 3	0 3	0 3	0 2½	0 2	0 2	0 2	
X	0 4	0 4	0 4	0 3	0 4	0 5	0 5	0 5	0 5	0 5	0 5	0 4	0 4	0 3	0 2½	0 2	0 3	0 2
Y	0 7	0 7	0 7	0 4	0 7	0 7	0 7	0 7	0 6	0 6	0 6	0 5	0 3	0 5	0 4	0 2	0 2	0 2
Z	0 9	0 9	0 9	0 6	0 9	0 9	0 9	0 9	1 4	1 2	1 0	0 10	0 9	0 7	0 7	0 5	0 4	0 4
A	*five*	*five*	*five*	*five*	*five*	*four*	*four*	*four*	*six*	*six*	*six*	*five*	*five*	*five*	*four*	*four*	*three*	*three*
B	0 1	0 1	0 0⅞	0 0¾	0 0⅞	0 0¾	0 0¾	0 3¾	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾
C	*four*	*four*	*four*	*four*	*four*	*three*	*three*	*three*	*six*	*six*	*six*	*five*	*five*	*four*	*four*	*four*	*three*	*three*
D	0 3½	0 3	0 3	0 2½	0 3	0 2½	0 2½	0 2½	0 4	0 4	0 4	0 3½	0 3½	0 3	0 3	0 2½	0 2½	0 2½
E	0 0⅝	0 0⅝	0 0½	0 0⅜	0 0½	0 0½	0 0½	0 0½	0 0¾	0 0¾	0 0¾	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0½	0 0½	0 0½
F	*two*	*two*	*two*	*one*	*one*	*one*	*one*	*one*	*two*	*two*	*two*	*two*	*two*	*one*	*one*	*one*	*one*	*one*
G	0 10	0 9¼	0 9¼	0 6	0 6¾	0 6¼	0 6¾	0 6½	0 11	0 10	0 10	0 9	0 8¾	0 7¾	0 6¾	0 5¾	0 6¼	0 5¼
H	0 10	0 9¼	0 9¼	0 6	0 6¾	0 6¼	0 6¾	0 6½	0 9	0 9	0 9	0 9	0 8¾	0 7¾	0 6¾	0 5¾	0 6¼	0 5¼
I	*five*	*five*	*six*	*five*	*six*	*five*	*six*	*five*	*six*	*six*	*six*	*five*	*five*	*five*	*five*	*four*	*five*	*four*
K	the post and standard.																	
L	3 4	3 2	3 0	...	3 6	...	...	...	3 9	3 9	3 3	2 9	2 3	1 9				
M	5 6	5 3	5 0	4 3	4 0	4 3	4 9	4 6	6 0	6 0	5 6	5 0	4 6	3 0	3 0	2 9	2 3	2 0
N	the other pintles to be in length within one inch of the back.																	
O	0 3[illegible]	0 3¼	0 3	0 2¾	0 3	0 3	0 3	0 3	0 4	0 4	0 4	0 3½	0 3	0 3	0 3	0 2¾	0 2½	0 2½
P	0 1⅜	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1¼	0 1¼	0 1¾	0 1½	0 1½	0 1⅜	0 1¼	0 1⅛	0 1⅛	0 1	0 1	0 0⅞

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
Rudder—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Pintles......*diameter*	0 4½	0 4¼	0 4	0 3½	0 3⅜	0 3¼	0 3⅛	0 3	0 3	0 2¾	A
long each	1 4	1 3	1 2	1 2	1 1	1 1	1 0	1 0	1 0	0 11	B
N. B. *The lower pintle to be two inches longer than the others, and the dumb pintles about two-thirds of the others, in length.*											
To have one or two bolts in each brace and pintle......*diameter*	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	C
And at every six inches distance screws in the braces, and nails and screws in pintles, *diameter*	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0½	0 0½	0 0½	0 0½	D
Ring Plate—To have a ring at the lower hance, straps and fastenings similar to a pintle.											
OUTBOARD.											
Channels—Main Channel......*in length*	39 0	38 0	37 6	37 6	27 9	27 0	26 0	28 6	27 0	22 9	E
thick at the inner edge	0 6½	0 6½	0 6	0 6	0 5½	0 5½	0 5½	0 5¼	0 5¼	0 5	F
thick at the outer edge	0 5	0 5	0 4½	0 4½	0 4½	0 4	0 4	0 3¾	0 3¾	0 3½	G
Breadth, or sufficient to clear the shrouds of the roughtree rail......	1 8	1 8	1 8	1 8	1 8	1 8	1 8	3 4	1 8	1 8	H
Foremost end afore the centre of the mainmast..	0 10	0 10	0 10	0 10	0 9	0 9	0 9	1 6	0 9	0 7	I
Upper edge below the upper edge of the sheer rail, or top timber line......	5 3	4 5	*well*	*well*	*well*	*well*	*well*	*well*	*well*	*well*	K
Bolted with bolts......*in number*	*eleven*	*eleven*	*ten*	*nine*	*nine*	*nine*	*eight*	*eight*	*eight*	*seven*	L
diameter	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	M
Fore Channel......*in length*	33 6	33 0	37 6	30 6	26 0	20 0	26 0	24 6	24 9	20 0	N
thick at the inner edge	0 6½	0 6½	0 6	0 6	0 5½	0 5½	0 5½	0 5¼	0 5¼	0 5	O
thick at the outer edge	0 5	0 5	0 4½	0 4½	0 4½	0 4	0 4	0 3¾	0 3¾	0 3½	P
Breadth, or sufficient to clear the shrouds of the roughtree rail......	1 8	1 8	1 8	1 8	1 8	1 8	1 8	3 4	1 8	1 8	Q
But taper at the after end to stow the anchor.											
Upper edge in the same range as the main channel.											
Foremost end afore the centre of the fore mast..	0 9	0 9	0 9	0 9	0 7	0 7	0 7	1 9	0 7	0 7	R
Bolted with bolts......*in number*	*ten*	*ten*	*nine*	*eight*	*eight*	*eight*	*seven*	*seven*	*seven*	*six*	S
diameter	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	T
Mizen channel......*in length*	19 6	19 6	20 0	19 6	17 0	16 0	15 0	16 9	14 6	14 0	U
thick at the inner edge	0 5½	0 5½	0 5	0 5	0 5	0 4½	0 4½	0 4½	0 4½	0 4½	X
thick at the outer edge	0 4¼	0 4¼	0 4	0 4	0 3¾	0 3½	0 3½	0 3½	0 3½	0 3¼	Y
Breadth, or sufficient to clear the shrouds of the roughtree rail......	1 8	1 8	1 8	1 8	1 8	1 8	1 8	3 0	1 8	1 8	Z
Upper edge above the range of the main channel, or......	...	...	*well*	...	...	*well*	1 9	*well*	1 0	1 0	A
Foremost end afore the centre of the mizen mast	0 9	0 9	0 6	0 6	0 6	0 6	0 6	*well*	0 6	0 6	B
Bolted with bolts......*in number*	*seven*	*seven*	*six*	*six*	*six*	*six*	*six*	*six*	*six*	*five*	C
diameter	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	D
Iron T-plates, or supporters in lieu of wood knees, in *number, main channel*	*six*	*six*	*six*	*six*	*six*	*six*	*five*	*five*	*five*	*five*	E
number, fore channel	*five*	*five*	*five*	*five*	*five*	*five*	*four*	*four*	*four*	*four*	F
Iron......*broad*	0 5	0 5	0 4½	0 4½	0 4½	0 4¼	0 4¼	0 4	0 4	0 4	G
Thick at the shoulder	0 2¾	0 2½	0 2¼	0 2¼	0 2	0 2	0 2	0 1¾	0 1¾	0 1¾	H
Thick at the toe......	0 1⅝	0 1½	0 1⅜	0 1⅜	0 1⅜	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	I
Length below the upper side of the channel....	4 6	4 3	4 0	4 0	4 0	3 9	3 9	3 9	3 9	3 9	K
Collar head bolt in the toe......*diameter*	0 1¾	0 1⅝	0 1½	0 1½	0 1½	0 1⅜	0 1½	0 1¼	0 1¼	0 1¼	L
Each plate to have an eye or ring in the upper end in the clear......	0 6	0 6	0 5½	0 5½	0 5½	0 5	0 5	0 5	0 5	0 5	M
diameter	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 1	N
Weight of each T-plate about......*cwt.*	1 2 0	1 1 14	1 1 0	1 1 0	1 1 0	1 0 16	1 0 9	1 0 9	1 0 9	1 0 0	O
Two or three bolts in the arms......*diameter*	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	P
Number of T-plates under the misen channel...	*four*	*four*	*four*	*four*	*three*	*three*	*three*	*three*	*three*	*two*	Q
The iron broad......	0 4	0 4	0 3½	0 3½	0 3½	0 3¼	0 3¼	0 3	0 3	0 3	R
Thick at the shoulder	0 1⅝	0 1⅝	0 1½	0 1½	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	S
Thick at the toe......	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 1	0 1	0 1	0 0⅞	T

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10.	GUNS 12	GUNS 10	GUNS 24.	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
A	0 2½	0 2¼	0 1⅞	0 1¾	0 1⅞	0 1¾	0 1¾	0 1¾	0 3¼	0 3⅛	0 3	0 2¾	0 2½	0 1⅞	0 1⅞	0 1¾	0 1⅝	0 1½
B	0 11	0 11	0 9	0 9	0 9	0 9	0 9	0 9	1 1	1 0	1 0	0 11	0 9	0 9	0 9	0 9	0 8	0 7
C	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅝	0 0⅝	0 0[illegible]
D	0 0½	0 0½	0 0½	0 0½	0 0½	0 0½	0 0½	0 0½	0 0⅝	0 0⅝	0 0⅝	0 0½	0 0½	0 0½	0 0½	0 0⅜	0 0⅜	0 0⅜
E	21 6	20 2	20 3	12 3	17 0	10 0	11 0	8 3	30 0	27 6	25 6	16 0	19 0	16 0	13 0	7 0	9 6	7 0
F	0 5	0 4¾	0 4½	0 4	0 4¼	0 4	0 4	0 4	0 5½	0 5½	0 5¼	0 5	0 4½	0 4½	0 4	0 3½	0 4	0 5
G	0 3½	0 3	0 2¾	0 2½	0 2¾	0 2½	0 3	0 3	0 4	0 4	0 4	0 3½	0 3¼	0 3	0 3	0 2¼	0 4	0 5
H	1 6	1 6	1 6	1 6	1 3	0 9	0 9	0 9	2 0	1 9	1 6	1 5	1 4	1 3	1 4	1 0	1 0	0 5
I	0 7	0 7	0 6	1 0	0 6	0 6	0 6	0 6	0 9	0 9	0 9	0 7	0 7	0 6	0 6	0 3	0 9	0 4
K	*well*	0 4	*w l*	1 4	*well*	2 0	2 11	1 8	3 10	3 8	3 6	1 2	*w ll*	*well*	*wel*	0 4	*well*	0 9
L	*seven*	*seven*	*seven*	*six*	*six*	*six*	*six*	*five*	*nine*	*nine*	*eight*	*seven*	*seven*	*seven*	*six*	*six*	*five*	*four*
M	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 1	0 1	0 1	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞
N	19 0	18 0	16 6	6 0	15 0	9 0	10 6	...	25 0	24 6	24 0	16 0	17 6	15 0	9 9	6 0	9 6	
O	0 5	0 4¾	0 4½	0 4	0 4¼	0 4	0 4	...	0 5½	0 5½	0 5¼	0 5	0 4½	0 4½	0 4	0 3½	0 4	
P	0 3½	0 3	0 2¾	0 2½	0 2¾	0 2½	0 3	...	0 4	0 4	0 4	0 3½	0 3¼	0 3	0 3	0 2¼	0 4	
Q	1 6	1 6	1 6	1 6	1 3	0 9	0 9	...	2 0	1 9	1 6	1 5	1 4	1 3	1 4	1 0	1 0	
R	0 6	0 6	0 6	1 0	0 6	0 6	0 6	0 6	0 9	0 9	0 9	0 7	0 7	0 6	0 6	0 6	0 9	
S	*six*	*six*	*six*	*five*	*five*	*five*	*six*	...	*eight*	*eight*	*ven*	*seven*	*six*	*six*	*five*	*five*	*five*	
T	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 1	0 1	0 1	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	
U	13 6	9 6	10 6	6 3	10 0	...	...	...	17 0	15 6	14 0	10 6	9 3	8 9	8 3			
X	0 4¼	0 4¼	0 4	0 3	0 4	...	...	...	0 5½	0 5½	0 5¼	0 5	0 4½	0 4½	0 4			
Y	0 3¼	0 3	0 2½	0 2	0 2¾	...	...	...	0 4	0 4	0 4	0 3½	0 3¼	0 3	0 3			
Z	1 8	1 8	1 8	1 4	0 10	...	...	...	2 0	1 9	1 6	1 4	1 2	1 1				
A	0 11	*well*	*well*	*well*	*well*	...	...	...	*well*	*well*	*well*	*wel*	*well*	*well*	*well*			
B	0 6	0 6	0 6	0 3	0 4	...	...	...	0 4	0 4	0 4	0 4	0 4	0 3	0 3			
C	*five*	*five*	*five*	*four*	*four*	...	...	...	*six*	*six*	*six*	*five*	*five*	*five*	*four*			
D	0 1	0 1	0 0⅞	0 0¾	0 0¾	...	...	...	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 0⅞	0 0⅞			
E	*four*	*four*	*four*	*three*	*three*	*three*	*three*	*three*	*five*	*five*	*five*	*four*	*four*	*three*	*three*	*two*		
F	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*four*	*four*	*four*	*four*	*three*	*three*	*three*	*two*		
G	0 3¾	0 3¾	0 3½	0 3	0 3¼	0 3	0 3	0 3	0 4½	0 4½	0 4¼	0 4	0 4	0 3½	0 3¼	0 3		
H	0 1⅝	0 1⅝	0 1½	0 1⅜	0 1½	0 1⅜	0 1⅜	0 1⅜	0 2	0 2	0 2	0 1¾	0 1¾	0 1¼	0 1½	0 1⅜		
I	0 1	0 1	0 1	0 0⅞	0 1	0 0⅞	0 0⅞	0 0⅞	0 1¼	0 1¼	0 1⅛	0 1	0 1	0 1	0 0⅞	0 0¾		
K	3 9	3 6	3 6	3 0	3 3	2 9	2 9	2 9	3 9	3 9	3 6	3 3	3 0	3 0	2 9	2 6		
L	0 1⅛	0 1⅛	0 1⅛	0 1	0 1⅛	0 1	0 1	0 1	0 1⅜	0 1⅜	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1	0 1		
M	0 4¾	0 4¾	0 4½	0 3½	0 4¼	0 3½	0 3½	0 3½	0 5	0 5	0 5	0 4¾	0 4½	0 4½	0 4	0 3½		
N	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾		
O	0 3 21	0 3 21	0 3 14	0 2 21	0 3 0	0 2 14	0 2 21	0 2 14	1 0 9	1 0 9	1 0 0	0 3 14	0 3 0	0 2 7	0 2 0			
P	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	0 0⅝	0 0⅝	0 0⅝	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0⅝			
Q	*two*	*two*	*two*	*two*	*two*	...	...	...	*four*	*four*	*four*	*three*	*three*	*two*				
R	0 3	0 2¾	0 2¾	0 2½	0 2¾	...	...	...	0 3½	0 3¼	0 3	0 3	0 3	0 2¾				
S	0 1⅛	0 1⅛	0 1⅛	0 1	0 1⅛	...	...	...	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛				
T	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0⅞	...	...	...	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞				

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
OUTBOARD—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Length below the upper side of the channel.....	2 9	2 9	2 7	2 7	2 6	2 6	2 4	2 4	2 4	2 4	A
Collar head bolt in the toe.........*diameter*......	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	B
Each plate to have an eye or ring in upper end in the clear..	0 4	0 4	0 3¾	0 3¾	0 3¾	0 3½	0 3½	0 3½	0 3½	0 3½	C
diameter......	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	D
Weight of each T-plate about.................*cwt.*	0 3 14	0 3 14	0 3 0	0 3 0	0 3 0	0 2 21	0 2 14	0 2 14	0 2 7	0 2 0	E
Two or three bolts through the arms, *diameter*...	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	F
DEAD EYES in MAIN and FORE CHANNELS. *Number in each main channel*...............	*twelve*	*eleven*	*eleven*	*eleven*	*eleven*	*eleven*	*ten*	*ten*	*ten*	*ten*	G
Number in each fore channel................	*twelve*	*eleven*	*eleven*	*eleven*	*eleven*	*eleven*	*ten*	*ten*	*ten*	*ten*	H
In diameter..	1 7	1 6	1 5	1 4	1 3	1 2	1 1	1 1	1 1	1 0	I
thickness..	0 10½	0 10	0 9½	0 9	0 8½	0 8	0 7½	0 7½	0 7½	0 7	K
Dead eyes for breast back stays in each channel..	*three*	*three*	*three*	*three*	*two*	*two*	*two*	*two*	*two*	*two*	L
in diameter......	1 0	1 0	0 11	0 11	0 10	0 9	0 9	0 9	0 9	0 9	M
thickness......	0 7	0 7	0 6½	0 6½	0 6	0 5	0 5	0 5	0 5	0 5	N
In the after end of each channel, to have one dead eye for topmast backstays, and one abaft that for the top-gallant backstays.......... *diameter*	1 0	1 0	0 11	0 10	0 10	0 10	0 9	0 9	0 9	0 9	O
thickness	0 7	0 7	0 6½	0 6	0 6	0 6	0 5	0 5	0 5	0 5	P
diameter	0 9	0 9	0 8	0 8	0 7	0 7	0 7	0 7	0 7	0 7	Q
thickness	0 5	0 5	0 4½	0 4½	0 4	0 4	0 4	0 4	0 4	0 4	R
STOOLS for topmast and top gallant backstay's dead eyes when there is not room in the after end of the channels................. ....*long*...	2 9	2 9	2 7	2 6	2 6	2 4	2 2	2 2	2 2	2 2	S
...................*broad*	2 4	2 3	2 2	2 2	2 2	2 1	2 0	2 0	2 0	1 10	T
thick *inner edge*....	0 4½	0 4½	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	U
thick *outer edge*.....	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	X
Stools to be bolted with two bolts, *in diameter*...	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 1	0 1	Y
DEAD EYES.—Number in each mizen channel............	*seven*	*six*	*six*	*six*	*six*	*six*	*five*	*five*	*five*	*five*	Z
diameter......	1 3	1 2	1 0	0 11	0 10	0 10	0 9	0 9	0 9	0 9	A
thickness......	0 8½	0 8	0 7	0 6½	0 6	0 6	0 5	0 5	0 5	0 5	B
STOOL.—To have a stool abaft the mizen channel for the top-mast and top-gallant backstays............................ ....*long*...	2 6	2 4	2 4	2 4	2 4	2 2	2 2	2 2	2 2	2 2	C
................*broad*...	2 0	2 0	1 10	1 10	1 10	1 10	1 10	1 9	1 9	1 9	D
thick *inner edge*......	0 4	0 4	0 3½	0 3½	0 3½	0 3½	0 3	0 3	0 3	0 3	E
thick *outer edge*......	0 3	0 3	0 2½	0 2½	0 2½	0 2½	0 2	0 2	0 2	0 2	F
Bolted with two bolts...........*in diameter*......	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	G
CHANNELS.—Dead-eye for mizen topmast backstay, *diameter*......	0 9	0 8	0 7	0 7	0 7	0 7	0 7	0 7	0 7	0 6	H
thickness......	0 5	0 4½	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 3½	I
Dead-eye for mizen top gallant backstay, *diameter*......	0 7	0 6	0 5	0 5	0 5	0 5	0 5	0 5	0 5	0 5	K
thickness......	0 4	0 3½	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	L
BINDINGS of the DEAD EYES Those of the main and fore channels, *diameter*......	0 1¾	0 1⅝	0 1⅝	0 1⅝	0 1⅝	0 1½	0 1½	0 1½	0 1½	0 1⅜	M
Mizen channel and topmast backstays	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	N
Main and fore chains (or plates) *size of the iron*	0 1¾	0 1⅝	0 1⅝	0 1⅝	0 1⅝	0 1½	0 1½	0 1½	0 1½	0 1⅜	O
Diameter of the chain bolts........................	0 2⅜	0 2¼	0 2⅛	0 2⅛	0 2⅛	0 2	0 2	0 2	0 2	0 1⅞	P
Diameter of the preventer bolts.....................	0 2	0 1⅞	0 1¾	0 1⅝	0 1⅝	0 1½	0 1½	0 1½	0 1½	0 1⅜	Q
Mizen chains and backstays (or plates) *size of the iron*......	0 1⅝	0 1½	0 1⅜	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	R
Diameter of their chain bolts......................	0 1¾	0 1⅝	0 1⅝	0 1⅝	0 1½	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1⅜	S
And driven below the channel......................	4 6	4 0	3 9	3 6	3 4	3 4	3 3	3 0	3 0	3 0	T
Preventer eye-bolts between the chain bolts to the main and fore	*six*	*six*	*six*	*six*	*six*	*six*	*five*	*five*	*five*	*five*	U
diameter.........	0 1¾	0 1⅝	0 1⅝	0 1⅝	0 1⅝	0 1½	0 1½	0 1½	0 1½	0 1⅜	X
eyes in the clear	0 4	0 4	0 3¾	0 3¾	0 3½	0 3½	0 3½	0 3½	0 3½	0 3½	Y
Preventer eye-bolts to the mizen chains, *number*	*four*	*four*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*two*	Z
diameter.........	0 1¾	0 1⅝	0 1⅝	0 1⅝	0 1½	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1⅜	A
eyes in the clear	0 2¾	0 2¾	0 2½	0 2½	0 2½	0 2½	0 2¼	0 2¼	0 2¼	0 2¼	B
Swivel Ring Bolts, two in each channel, *diameter*	0 1⅛	0 1⅛	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	C
eyes in the clear...	0 2¾	0 2¾	0 2½	0 2½	0 2½	0 2¼	0 2¼	0 2¼	0 2¼	0 2¼	D
Eye-bolt driven in the side close before the fore channel for studding sail boom *diameter*...........	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	E
eye in the clear....	0 2	0 2	0 2	0 2	0 2	0 1¾	0 1¾	0 1¾	0 1¾	0 1½	F

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	2 4	2 4	2 2	2 0	2 2	…	…	…	2 4	2 4	2 4	2 4	2 4	2 2				
B	0 1	0 1	0 1	0 0⅞	0 1	…	…	…	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1				
C	0 3½	0 3¼	0 3¼	0 3	0 3¼	…	…	…	0 3½	0 3½	0 3½	0 3¼	0 3¼	0 3				
D	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	…	…	…	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾				
E	0 1 21	0 1 14	0 1 7	0 1 3	0 1 5	…	…	…	0 2 14	0 2 14	0 2 7	0 2 0	0 1 21	0 1 7				
F	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	…	…	…	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅝			
G	*ten*	*ten*	*nine*	*six*	*eight*	*five*	*seven*	*five*	*eleven*	*eleven*	*nine*	*six*	*six*	*six*	*five*	*four*	*four*	*three*
H	*ten*	*ten*	*eight*	*five*	*seven*	*five*	*six*	…	*ten*	*ten*	*eight*	*six*	*six*	*six*	*four*	*four*	*four*	
I	1 0	1 0	0 11	0 10	0 11	0 9	0 11	0 10	1 1	1 0	1 0	0 11	0 10	0 10	0 9	0 7	0 8	0 8
K	0 7	0 7	0 6½	0 6	0 6½	0 5	0 6½	0 6	0 7½	0 7	0 7	0 6½	0 6	0 6	0 5	0 4	0 4½	0 4½
L	*two*	*two*	*two*	*one*	*one*	*one*	*one*	*one*	*two*	*two*	*two*	*two*	*one*	*one*				
M	0 8	0 8	0 8	0 6	0 7	0 6	0 7	0 7	0 9	0 9	0 9	0 8	0 8	0 8				
N	0 4½	0 4½	0 4½	0 3½	0 4	0 3½	0 4	0 4	0 5	0 5	0 5	0 4½	0 4½	0 4½				
O	0 8	0 8	0 8	0 7	0 8	0 7	0 8	0 8	0 10	0 9	0 9	0 8	0 8	0 8				
P	0 4½	0 4½	0 4½	0 4	0 4½	0 4	0 4½	0 4½	0 6	0 5	0 5	0 4½	0 4½	0 4½				
Q	0 7	0 7	0 7	0 5	0 7	0 6	0 7	0 7	0 7	0 7	0 7	0 7	0 7	0 6				
R	0 4	0 4	0 4	0 3	0 4	0 3½	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 3½				
S	2 2	2 0	…	2 4	2 0	…	…	…	…	…	…	…	…	…	2 6			
T	1 10	1 10	…	1 3	1 8	…	…	…	…	…	…	…	…	…	1 3			
U	0 3½	0 3½	…	0 3	0 3½	…	…	…	…	…	…	…	…	…	0 3			
X	0 2½	0 2½	…	0 2½	0 2½	…	…	…	…	…	…	…	…	…	0 2½			
Y	0 0⅞	0 0⅞	…	0 0¾	0 0⅞	…	…	…	…	…	…	…	…	…	0 0⅞			
Z	*five*	*four*	*four*	*four*	*four*	…	…	…	*six*	*six*	*four*	*four*	*four*	*four*				
A	0 8	0 8	0 8	0 7	0 8	…	…	…	0 10	0 9	0 9	0 8	0 8	0 8				
B	0 4½	0 4½	0 4½	0 4	0 4½	…	…	…	0 6	0 5	0 5	0 4½	0 4½	0 4½				
C	2 0	2 0	2 0	…	1 10	…	…	…	2 2	2 2	2 0	1 10	1 10	1 9				
D	1 8	1 8	1 6	…	1 6	…	…	…	1 9	1 9	1 8	1 8	1 6	1 4				
E	0 3	0 3	0 2½	…	0 2½	…	…	…	0 3½	0 3½	0 3½	0 3	0 3	0 3				
F	0 2	0 2	0 2	…	0 2	…	…	…	0 2½	0 2½	0 2½	0 2	0 2	0 2				
G	0 0¾	0 0¾	0 0¾	…	0 0¾	…	…	…	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾				
H	0 6	0 6	0 6	0 5	0 5	…	…	…	0 7	0 7	0 7	0 6	0 6	0 5				
I	0 3½	0 3½	0 3½	0 3	0 3	…	…	…	0 4	0 4	0 4	0 3½	0 3½	0 3				
K	0 5	0 5	0 5	…	…	…	…	…	0 5	0 5	0 5	0 5	0 5					
L	0 3	0 3	0 3	…	…	…	…	…	0 3	0 3	0 3	0 3	0 3					
M	0 1⅜	0 1¼	0 1¼	0 1⅛	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¾	0 1¾	0 1⅝	0 1⅜	0 1¼	0 1¼	0 1⅛	0 1	0 1⅛	0 1
N	0 1⅛	0 1	0 1	0 0⅞	0 1	0 0⅞	0 0⅞	0 0⅞	0 1⅜	0 1¼	0 1¼	0 1⅛	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 0¾
O	0 1⅜	0 1¼	0 1¼	0 1⅛	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¾	0 1¾	0 1⅝	0 1⅜	0 1¼	0 1¼	0 1⅛	0 1	0 1⅛	0 1
P	0 1¾	0 1⅝	0 1⅜	0 1⅜	0 1½	0 1½	0 1½	0 1⅝	0 1¾	0 1¾	0 1⅝	0 1½	0 1⅜	0 1⅜	0 1⅜	0 1¼	0 1⅜	0 1¼
Q	0 1⅜	0 1¼	0 1¼	…	…	…	…	…	0 1½	0 1½	0 1¼	0 1¼	0 1⅛	0 1⅛				
R	0 1¼	0 1⅛	0 1⅛	0 1	0 1⅛	…	…	…	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1⅛	0 1				
S	0 1⅜	0 1¼	0 1⅛	0 1⅛	0 1¼	…	…	…	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1⅛	0 1				
T	3 0	2 9	2 6	2 0	2 3	…	…	…	3 4	3 4	3 3	3 0	2 9	2 6				
U	*four*	*four*	*four*	*three*	*three*	*two*	*two*	*two*	*six*	*six*	*five*	*five*	*four*	*three*	…	*two*	*two*	*two*
X	0 1⅜	0 1¼	0 1¼	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¾	0 1¾	0 1⅝	0 1⅜	0 1¼	0 1¼	…	0 1⅛	0 1	0 1
Y	0 3¼	0 3¼	0 3	0 2½	0 3	0 3	0 3	0 3	0 3½	0 3½	0 3½	0 3¼	0 3	0 2¾	…	0 2½	0 2¼	0 2
Z	*two*	*two*	*two*	*two*	*two*	…	…	…	*three*	*three*	*three*	*two*	*two*	*two*				
A	0 1⅜	0 1¼	0 1⅛	0 1⅛	0 1¼	…	…	…	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1⅛	0 1				
B	0 2	0 2	0 2	0 1¾	0 2	…	…	…	0 2¼	0 2¼	0 2¼	0 2	0 2	0 2				
C	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0¾	…	0 0¾	0 0¾	0 0¾
D	0 2	0 2	0 2	0 1[illegible]	0 2	0 2	0 2	0 2¼	0 2¼	0 2¼	0 2¼	0 2	0 2	0 2	0 2	0 1¾	0 1¾	0 1¾
E	0 1⅛	0 1	0 1	0 0⅞	0 1	0 0⅞	0 0⅞	0 0⅞	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 1	0 0⅞		
F	0 1½	0 1¾	0 1⅜	0 1½	0 1⅜	0 1¼	0 1¼	0 1¼	0 2	0 2	0 1¾	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼		

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
OUTBOARD—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in*	*ft. in.*	*ft. in.*	*ft. in.*	
SHANKPAINTER CHAINS—One on each side.......*in length*	13 6	13 6	13 6	13 6	12 6	12 6	11 6	11 6	11 6	11 6	A
Links in diameter	0 1	0 1	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	B
Bolt in diameter..	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	C
GOOSENECK and EYESTRAP to each MAIN CHANNEL..... Straps, iron, thick at shoulder..........	0 2½	0 2⅜	0 2¼	0 2¼	0 2⅛	0 2⅛	0 2	0 2	0 2	0 2	D
Neck to spread in the clear............	1 6	1 5	1 4	1 4	1 3	1 3	1 2	1 2	1 2	1 1	E
Eye in the clear........................	0 2	0 2	0 2	0 2	0 2	0 1¾	0 1¾	0 1¾	0 1¾	0 1⅝	F
Eye to project from the channel........	0 7	0 6	0 6	0 6	0 5	0 5	0 5	0 5	0 5	0 5	G
Straps of each.....................*broad*	0 4¾	0 4½	0 4½	0 4½	0 4¼	0 4¼	0 4	0 4	0 3¾	0 3½	H
thick at outer edge	0 1½	0 1⅜	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	I
inner edge	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0½	K
Bolted through the channel with three-eye bolts in each...................................*diameter*	0 1⅛	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	L
LININGS for the ANCHOR—Bolster, oak...........*in length*	10 6	10 0	9 6	9 0	8 6	8 0	7 6	7 6	7 6	7 0	M
broad	1 2	1 1	1 0	1 0	0 11	0 11	0 10	0 10	0 10	0 9	N
deep..	1 0	0 11	0 11	0 11	0 10	0 10	0 9	0 9	0 9	0 8	O
Four bolts in the bolster.................*diameter*	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	P
Stantions for the lining.....................*number*	*four*	*four*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	*three*	Q
sided, or fore and aft...	0 6	0 5½	0 5	0 5	0 5	0 5	0 4½	0 4½	0 4½	0 4	R
moulded, or thwartships	0 7	0 6½	0 6	0 6	0 6	0 6	0 5½	0 5½	0 5½	0 5	S
Lining, oak plank...............................*thick*	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	T
Fastened with saucer-head bolts to forelock, two at each end...............................*diameter*	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0	0 0¾	U
CHESTREES—One on each side.........................*sided*	0 10	0 10	0 10	0 10	0 9	0 9	0 8	0 8	0 8	0 7	X
Moulded at the upper part.........................	0 8	0 8	0 8	0 8	0 7	0 7	0 6	0 6	0 6	0 5	Y
Taper at the heel to................................	0 3	0 3	0 3	0 3	0 2½	0 2½	0 2	0 2	0 2	0 1½	Z
In length from the top of the side.................	11 6	11 0	6 6	6 0	5 6	5 0	7 0	6 10	6 10	6 0	A
To have a sheave or roller in the head, *diameter*	0 9	0 9	0 9	0 9	0 8	0 8	0 7	0 7	0 7	0 6	B
in thickness	0 4½	0 4	0 4	0 4	0 3½	0 3½	0 3	0 3	0 3	0 2½	C
To be fixed abaft the fore drift *(or where the main yardarm plumbs with the side when braced sharp)*	11 0	7 3	3 9	5 0	4 6	5 0	5 0	5 0	7 0	3 3	D
Bolted there with bolts..................*in number*	*four*	*four*	*four*	*four*	*four*	*four*	*three*	*three*	*three*	*three*	E
diameter	0 1	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	F
FENDERS—Abreast the main hatchway................*sided*	0 5	0 5	0 5	0 5	0 5	0 4½	0 4½	0 4½	0 4½	0 4	G
taper in the length	0 1½	0 1½	0 1½	0 1½	0 1½	0 1¼	0 1¼	0 1¼	0 1¼	0 1	H
moulded, upper end	0 7	0 6½	0 6	0 6	0 5½	0 5	0 5	0 5	0 5	0 5	I
Length is, from the upper edge of main wales to the top of the side.................................											
Bolted with three bolts...................*diameter*	0 1	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	K
RAILS and DRIFTS—The upper edge of the sheer rail to sheer agreeable to the top timber line, and to be above the upper edge of the rabbet of the keel.......... *afore...*	47 9	44 10	40 10	38 0	35 9	33 10	30 6	29 6	29 0	27 8	L
midship	45 6	42 10	37 6	35 4	32 9	32 0	27 3	27 5	27 0	25 8	M
abaft...	54 4	48 4	42 8	41 3	38 3	37 3	31 6	31 6	31 0	29 3	N
Upper edge of the waist rail below the upper edge of the sheer rail, and parallel thereto....	2 2	2 0	2 2	2 3	2 0	1 10	2 3	1 10	1 10	1 9	O
Upper edge of the channel rail below the upper edge of the sheer rail and parallel thereto.. ..	...	...	...	...	...	...	...	...	...	...	P
Upper edge of the drift rail above the upper edge of the sheer rail......... *forward*	2 0	1 8	1 11	1 9	1 10	1 10	1 4	1 4	1 4	1 2	Q
aft.....	3 8	2 8	3 2	2 4	3 10	2 7	2 0	2 7	1 1	1 10	R
Upper edge of the main drift above the upper edge of the sheer rail...........................	2 5	1 8	2 1	1 9	2 0	1 7	1 2	1 4	1 2	1 2	S
Upper edge of fife rail above the upper edge of the drift rail and parallel thereto ......*aft*......	1 6	1 3	1 3	1 6	1 6	1 4					
Underside of planksheer above the drift rail, or fife rail, and parallel thereto.......... *forward*	1 0	0 11	0 7	0 9	0 9	0 9	0 6	0 8	0 6	0 8	
aft......	1 4	2 9	1 8	2 6	2 4	2 6	0 6	0 9	0 6	0 9	U
Aft part of the fore drift abaft the aft side of the after beam of the forecastle....................	2 10	1 4	1 4	1 3	1 2	1 0	1 0	1 0	1 0	1 0	X
Fore part of main drift afore the foreside of the foremost beam of quarter deck.................	2 10	7 11	4 6	1 3	6 10	1 0	1 0	0 7	*well*	*well*	Y

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
—	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	10 6	10 6	9 6	8 6	9 0	9 0	9 0	9 0	12 6	12 6	11 6	11 6	10 6	9 6	9 0	9 0	7 6	7 0
B	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	0 0⅝	0 0⅝	0 0⅝	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0⅝	0 0⅝	0 0½
C	0 1	0 1	0 0⅞	0 0¾	0 0⅞	0 0¾	0 0¾	0 0¾	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 1	0 1	0 0¾	0 0¾	0 0¾
D	0 1⅞	0 1⅞	0 1¾															
E	1 1	1 1	1 0															
F	0 1⅝	0 1½	0 1⅜															
G	0 5	0 5	0 4½															
H	0 3½	0 3¼	0 3															
I	0 1	0 1	0 1															
K	0 0½	0 0⅜	0 0⅜															
L	0 0¾	0 0¾	0 0¾															
M	7 0	6 9	6 6	5 0	5 6													
N	0 9	0 8	0 8	0 6	0 7													
O	0 8	0 7	0 7	0 5	0 6													
P	0 1	0 1	0 0⅞	0 0⅞	0 0⅞													
Q	*three*	*three*	*two*	*two*	*two*	} Sometimes not used.												
R	0 4	0 4	0 4	0 3	0 3½													
S	0 5	0 5	0 5	0 4	0 5													
T	0 2½	0 2½	0 2¼	0 2	0 2¼													
U	0 0¾	0 0¾	0 0¾	0 0⅝	0 0⅝													
X	0 7	0 7	0 6	0 4	0 5	0 4	0 4	0 4	0 9	0 8	0 7	0 6	0 6	0 5½				
Y	0 5	0 5	0 4½	0 3½	0 4	0 4	0 4	0 4	0 7	0 6	0 5	0 4½	0 4½	0 3½				
Z	0 1½	0 1½	0 1½	0 1¼	0 1½	0 1½	0 1½	0 1½	0 2½	0 2	0 1½	0 1½	0 1½	0 1½				
A	6 0	6 0	5 6	4 0	5 0	2 0	2 3	2 3	6 10	6 10	6 6	6 0	6 0	5 6				
B	0 6	0 6	0 5	0 3½	0 4	0 3½	0 3½	0 3½	0 8	0 7	0 6	0 5	0 5	0 4½				
C	0 2½	0 2½	0 2	0 1½	0 1⅜	0 1½	0 1½	0 1½	0 3½	0 3½	0 3¼	0 3	0 3	0 2½				
D	5 10	5 9	...	6 3	5 0													
E	*three*	*three*	*three*	*three*	*three*	*two*	*two*	*two*	*four*	*four*	*four*	*three*	*three*	*three*				
F	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾				
G	0 4	0 4	0 3½	...	...	...	...	...	0 5¾	0 5½	0 5½	0 5	0 4¾	0 4¼	0 4			
H	0 1	0 1	0 1	...	...	...	...	...	0 1½	0 1½	0 1½	0 1½	0 1¼	0 1¼	0 1¼			
I	0 4½	0 4½	0 4	...	...	...	...	...	0 6½	0 6½	0 6	0 6	0 5½	0 5	0 4¾			
K	0 0¾	0 0¾	0 0⅝	...	...	...	...	...	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾			
L	27 0	25 2	18 4	16 4	20 8	17 6	22 9	19 4	39 0	34 9	36 0	26 9	28 9	26 5	17 3	10 3	18 11	12 4
M	24 1	23 0	16 7	14 9	17 9	15 3	18 6	16 6	36 0	31 7	33 5½	24 8½	26 6½	22 10½	15 11	9 6½	16 7	10 10
N	27 10	26 9	20 4	18 2	21 9	19 0	25 1	19 7	39 10	35 0	37 0	28 0	29 6	27 6	20 3	15 9	19 11	13 5
O	1 9	1 9	1 6	1 4	1 5	1 2	1 6	1 4	2 0	1 9	1 6	1 2	1 1	1 6	1 3	...	1 1	0 10
P	...	...	...	...	...	...	...	...	4 0	1 6	1 6	1 2						
Q	1 2	1 2	0 11	0 8	1 2	...	...	...	...	1 9	1 4	...	1 0					
R	1 10	1 10	0 11	0 10	1 2	...	...	...	2 0	1 9	1 4	...	1 0	1 3				
S	1 2	1 4	...	0 10	...	...	...	...	2 0									
T	0 8	0 7	0 6	0 5	...	...	...	...	0 8	0 10	0 10	0 5	0 8	0 11	...	...	0 6	
U	0 9	0 8	0 6	0 8	...	...	...	...	0 9	0 9	0 8	0 6	0 6	0 9	...	...	0 6	0 4
X	1 0	1 6	1 0	5 0														
Y	3 6	3 3	*well*	3 9														

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
OUTBOARD—*continued.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
Fore part of the next drift abaft the main drift from the fore part	16 0	12 6	11 0	10 6	9 6	17 0	9 0	9 0	8 6	8 6	A
Fore part of the roundhouse hance afore the foreside of the foremost beam of the roundhouse	2 0	7 3	2 6	2 0	3 0	2 0					
Aft part of fore drift abaft the centre of the fore mast	...	...	...	...	...	...	...	...	...	...	B
Fore part of main drift abaft the centre of the main mast	...	...	...	...	...	...	...	...	...	...	C
Fore part of the next drift aft abaft the centre of the main mast	...	...	...	...	...	...	...	...	...	...	D
Plank sheer drift abaft the centre of the fore mast	...	...	...	...	...	...	...	...	...	...	E
Plank sheer drift abaft the centre of the main mast	...	...	...	...	...	...	...	...	...	...	F
Sheer rails *broad*	0 7	0 7	0 6½	0 6½	0 6	0 5½	0 5	0 4¾	0 4¾	0 4½	G
thick	0 3	0 3	0 3	0 3	0 2¾	0 2½	0 2¼	0 2¼	0 2¼	0 2¼	H
Channel and Waist rails *broad*	0 8½	0 8½	0 8	0 7	0 6¾	0 6	0 6	0 5¾	0 5½	0 5½	I
thick	0 3½	0 3½	0 3¼	0 3¼	0 3	0 2¾	0 2½	0 2½	0 2½	0 2½	K
Drift rails *broad*	0 6	0 6	0 5¾	0 5½	0 5¼	0 5	0 4½	0 4¼	0 4¼	0 4	L
thick	0 2¾	0 2¾	0 2½	0 2½	0 2¼	0 2¼	0 2	0 2	0 2	0 2	M
Fife rails *broad*	1 0	1 0	0 11	0 11	0 11	0 11	0 10	0 10	0 10	0 10	N
thick	0 4½	0 3	0 3	0 3	0 2¾	0 2¾	0 2½	0 2½	0 2½	0 2½	O
Plank sheers *thick*	0 3½	0 3½	0 3½	0 3½	0 3	0 3	0 3	0 3	0 3	0 3	P
Plank sheers cypher'd at the edges to	0 3	0 3	0 3	0 3	0 2½	0 2½	0 2½	0 2½	0 2½	0 2½	Q
N. B. The ornamental rails on the sides of merchant ships are generally wrought from the solid plank. The planks wrought											R
IRON WORK along the sides, &c.											
Eye bolts for the bowsprit shrouds, two on each side *diameter*	0 1½	0 1½	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	S
eyes in clear	0 3	0 3	0 3	0 3	0 2¾	0 2¾	0 2⅝	0 2⅝	0 2⅝	0 2½	T
Eye bolts for standing part of the tacks and sheets, one under each block *diameter*	0 1⅝	0 1⅝	0 1½	0 1½	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1⅜	U
eyes in clear	0 3¼	0 3¼	0 3¼	0 3¼	0 3	0 3	0 2¾	0 2¾	0 2¾	0 2¾	X
Swivel eye driven on a plate on the cathead for the fore studding sail boom *diameter*	...	...	...	...	...	...	...	...	...	...	Y
eye in clear	...	...	...	...	...	...	...	...	...	...	Z
Swivel eye driven on a plate under the fore part of the mizen chains for the long boat *diameter*	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	A
eye in clear	0 3½	0 3½	0 3½	0 3½	0 3¼	0 3¼	0 3¼	0 3¼	0 3¼	0 3¼	B
To have an eye bolt driven in the turn of each buttock for the rudder pendants *diameter*	0 1⅜	0 1⅜	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	C
eyes in clear	0 3	0 3	0 3	0 3	0 2¾	0 2¾	0 2¾	0 2¾	0 2¾	0 2⅝	D
To have two eye bolts in the head of each quarter piece for mizen vangs and stern ladders *diameter*	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	E
eyes in clear	0 2¾	0 2¾	0 2¾	0 2¾	0 2½	0 2½	0 2½	0 2½	0 2½	0 2⅜	F
To have eye bolts for mizen sheets, main and fore braces, topsail haliards, and mizen truss *diameter*	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	G
eyes in clear	0 2½	0 2½	0 2½	0 2½	0 2⅜	0 2¼	0 2¼	0 2¼	0 2¼	0 2¼	H
IRON STRAP COLLAR fastened to the side of the stern for the bowsprit *thickness*	...	...	...	...	...	..	...	...	...	...	I
broad	...	...	...	...	...	...	...	...	...	...	K
Bolts, *in number*	...	...	...	...	...	...	...	...	...	...	L
diameter	...	...	...	...	...	...	...	...	...	...	M
IRON HORSE for main sheet, or two eye-bolts *diameter*	...	...	...	...	...	...	...	...	...	...	N
diameter	...	...	...	...	...	...	...	...	...	...	O
eyes in clear	...	...	...	...	...	...	...	...	...	...	P
IRON CRUTCHES or Stantions for rough trees *number*	..	...	...	...	...	...	...	...	...	...	Q
diameter	...	...	...	...	...	...	...	...	...	...	R
BINNACLES Complete *number*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	S

	Frigates.		Sloop of War.	*Denmark* Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	8 6	8 6	7 0	3 9														
B	...	...	...	...	...	...	...	...	...	18 6	12 0	5 9	...	7 3	...	...	9 0	
									afore it.								*afore it.*	
C	...	...	...	...	...	...	...	...	4 6	2 0	1 0	12 6	...	*well*	...	...	6 6	13 8
D	...	...	...	...	...	...	...	...	...	20 0	...	18 0						
E	...	...	...	...	...	...	...	...	23 0	5 4	...	4 6	...	...	...	...	9 0	
																	afore it.	
F	...	...	...	...	...	...	...	...	36 6	33 0	32 0	...	...	11 9	...	...	6 6	3 8
G	0 4¼	0 4¼	0 4	0 4	0 4	0 3½	0 3½	0 3½	0 6	0 6	0 6	0 4	0 4	0 4	0 3½	...	0 3	0 3
H	0 2¼	0 2¼	0 2¼	0 2	0 2¼	0 2	0 2	0 2	0 2½	0 2¼	0 2¼	0 2	0 2	0 1¾	0 2	...	0 1¾	0 1½
I	0 5¼	0 5¼	0 5	0 4½	0 4¾	0 4½	0 4½	0 4½	0 5	0 5	0 6	0 4	0 4	0 4	0 4	...	0 4	
K	0 2½	0 2½	0 2¼	0 2¼	0 2¼	0 2¼	0 2¼	0 2¼	0 2½	0 2½	0 2½	0 2¼	0 2¼	0 2¼	0 2¼	...	0 2	
L	0 3¾	0 3¾	0 3½	0 3	0 3¼	...	...	...	0 4	0 4	0 3½	0 3	0 3	0 3				
M	0 2	0 2	0 1¾	0 1¾	0 1¾	...	...	...	0 2¼	0 2¼	0 2¼	0 2	0 2	0 1¾				
N	0 10	0 10	0 10	0 9														
O	0 2¼	0 2½	0 2½	0 2														
P	0 3	0 3	0 2½	0 2½	...	...	...	...	0 4	0 3½	0 3	0 3	0 3	0 2½	...	0 2	0 2	0 2
Q	0 2½	0 2½	0 2	0 2¾	0 2½	...	...	...	0 3½	0 3	0 2½	0 2½	0 2½	0 2	...	0 1¾	0 1¾	0 1¾
R	in wake of the rails are consequently thick enough to raise the mouldings.																	
S	0 1⅛	0 1⅛	0 1	0 0⅞	0 1	0 1	0 1	0 1	0 1⅜	0 1⅜	0 1¼	0 1⅛	0 1⅛	0 1	0 1	0 0⅞	0 0⅞	0 0⅞
T	0 2½	0 2½	0 2¼	0 2	0 2¼	0 2¼	0 2¼	0 2¼	0 3	0 3	0 2¾	0 2¾	0 2⅝	0 2½	0 2¼	0 2¼	0 2	0 2
U	0 1¼	0 1¼	0 1¼	0 1⅛	0 1¼	0 1¼	0 1¼	0 1¼	0 1½	0 1½	0 1⅜	0 1¼	0 1¼	0 1⅛	0 1[illegible]	0 1	0 1	0 1
X	0 2⅝	0 2⅝	0 2⅜	0 2¼	0 2½	0 2⅜	0 2⅜	0 2⅜	0 3¼	0 3¼	0 3	0 3	0 2¾	0 2¾	0 2½	0 2⅜	0 2¼	0 2¼
Y	...	...	...	...	...	...	...	...	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 1	0 1	0 0⅞		
Z	...	...	...	...	...	...	...	...	0 2	0 2	0 2	0 1¾	0 1¾	0 1⅝	0 1½	0 1⅝		
A	0 1¼	0 1¼	0 1⅛	0 1	0 1⅛	...	...	...	0 1⅜	0 1⅜	0 1¼	0 1¼	0 1⅛	0 1⅛				
B	0 3¼	0 3¼	0 3⅛	0 3	0 3⅛	...	...	...	0 3¼	0 3¼	0 3¼	0 3	0 3	0 3				
C	0 1⅛	0 1⅛	0 1	0 0⅞	0 1	...	...	...	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	0 1			
D	0 2⅝	0 2½	0 2⅜	0 2⅛	0 2¼	...	...	...	0 2¾	0 2¾	0 2¾	0 2½	0 2⅜	0 2½	0 2½			
E	0 1⅛	0 1⅛	0 1	0 0⅞	0 1	...	...	...	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 0⅞		
F	0 2⅜	0 2¼	0 2⅛	0 2	0 2⅛	...	...	...	0 2½	0 2½	0 2½	0 2¼	0 2¼	0 2¼	0 2¼	0 2⅛		
G	0 1⅛	0 1⅛	0 1	0 0⅞	0 1	...	...	...	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 0⅞	0 0¾	0 0¾
H	0 2¼	0 2¼	0 2⅛	0 2	0 2⅛	...	...	...	0 2¼	0 2¼	0 2¼	0 2¼	0 2¼	0 2⅛	0 2⅛	0 2	0 1¾	0 1¾
I	...	...	...	...	...	...	...	0 1	...	...	...	...	...	...	...	...	...	0 0¾
K	...	...	...	...	...	...	...	0 7	...	...	...	...	...	...	...	...	...	0 5
L	...	...	...	...	...	...	...	*four*	...	...	...	...	...	...	...	...	...	*four*
M	...	...	...	...	...	...	...	0 0¾	...	...	...	...	...	...	...	...	...	0 0⅝
N	...	...	...	...	...	0 2	0 2⅛	0 2¼	...	...	...	...	...	...	...	0 2	0 1¾	0 1⅝
O	...	...	...	...	...	0 1¾	0 2	0 2⅛	...	...	...	...	...	...	...	0 1¾	0 1⅝	0 1½
P	...	...	...	...	...	0 5	0 5½	0 5¾	...	...	...	...	...	...	...	0 5⅝	0 5⅜	0 5
Q	...	...	...	...	...	...	...	...	...	...	...	...	*five*	*four*	*four*	...	*four*	*four*
R	...	...	...	...	...	...	...	...	...	...	...	...	0 1¼	0 1¼	0 1¼	...	0 1¼	0 1⅛
S	*two*	*two*	*two*	*two*	*one*	*one*	*one*	*one*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*one*	*one*	*one*

A TABLE OF THE WEIGHT AND

PARTICULARS OF EACH DIMENSION, OR SCANTLING.	Of Three Decks.		Of Two Decks.				Frigates.				
	GUNS 110	GUNS 98	GUNS 80	GUNS 74	GUNS 64	GUNS 50	GUNS 44	GUNS 38	GUNS 36	GUNS 32	
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
WEIGHT OF ANCHORS	83 *cwt.*	81 *cwt.*	73 *cwt.*	71 *cwt.*	67 *cwt*	57 *cwt*	49 *cwt.*	44 *cwt.*	40 *cwt.*	34 *cwt.*	A
ANCHOR STOCKS, in *number* ... *large*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	*four*	B
small	*three*	*three*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	*two*	C
length	22 0	21 9	20 6	20 0	19 6	19 0	18 6	17 6	17 0	16 6	D
Square at the ... *middle*	1 10	1 9¾	1 8½	1 8	1 7½	1 7	1 6½	1 5½	1 4½	1 4	E
Square at the ... *ends*	0 11	0 10⅞	0 10¼	0 10	0 9¾	0 9½	0 9¼	0 8¾	0 8¼	0 8	F
Opening left between the pieces in the middle	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1¼	0 1	0 1	0 1	0 1	G
Bolted with four bolts, in *diameter*	0 1⅛	0 1⅛	0 1⅛	0 1⅛	0 1	0 1	0 1	0 1	0 1	0 1	H
Hoop'd with iron.											
Four hoops to each ... *thick*	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0⅝	0 0⅝	I
broad	0 3½	0 3½	0 3¼	0 3¼	0 3	0 3	0 3	0 3	0 3	0 3	K

A TABLE OF THE DIMENSIONS AND

PARTICULARS, &c.	SPECIES. / LENGTHS.	LONG-BOATS. Feet 32	Feet 30	Feet 26	Feet 22	Feet 19	
		ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	
BREADTH ... Moulded		9 6	9 3	8 9	7 6	7 1	L
DEPTH ... in midships		4 3	4 1	3 8	3 6	2 10	M
afore		5 6	5 4	4 9	4 2	3 3	N
abaft		5 7	5 5	4 10	4 3	3 4	O
KEEL ... Sided in midships		0 5½	0 5	0 4¾	0 4⅜	0 3¾	P
Deep below the rabbet		0 6½	0 6	0 5¾	0 5½	0 5	Q
To be above the rabbet for Deadwood		0 1¼	0 1	0 0⅞	0 0¾	0 0¾	R
STEM ... Sided		0 4½	0 4	0 3⅞	0 3¾	0 3½	S
Afore the rabbet at the head		0 7	0 6½	0 6	0 5½	0 5	T
Abaft the rabbet		0 1¾	0 1¾	0 1⅝	0 1⅜	0 1⅜	U
TRANSOM ... Broad or moulded at the upper part		5 11	5 8	5 3	3 9	3 4	X
Thick, or sided		0 4	0 4	0 3½	0 3	0 2¼	Y
Knees, sided		0 3½	0 3½	0 3¼	0 2¾	0 2	Z
STERN-POST ... Sided at the tuck		0 4¾	0 4¼	0 3¾	0 3¼	0 3	A
at the keel		0 3½	0 3¼	0 2¾	0 2⅝	0 2½	B
Broad, or fore and aft at the keel		1 4	1 2	1 1	1 0	0 10	C
(Transom included) at the head		0 8¼	0 7½	0 6¾	0 5	0 4½	D
FLOOR-TIMBERS ... Sided		0 3	0 3	0 2¾	0 2½	0 1¾	E
Moulded at the head		0 3	0 3	0 2½	0 2¼	0 1⅝	F
at the throat		0 5¼	0 5	0 4½	0 4¼	0 3¾	G
FUTTOCKS ... Sided at the heels		0 3	0 2¾	0 2½	0 2⅛	0 1¾	H
at the heads		0 2¾	0 2½	0 2	0 1⅞	0 1½	I
Moulded at the heads		0 2¾	0 2½	0 2	0 1⅞	0 1½	K
Scarph of the timbers		3 0	2 10	2 4	2 0	1 10	L
KEELSON ... *Broad*		1 1	1 0	1 0	0 11	0 10½	M
Thick		0 3	0 3	0 2½	0 1¾	0 1½	N
FOOTWALLING ... *Thick*		0 1¼	0 1¼	0 1	0 1	0 1	O
RISING ... *Broad*		0 10	0 10	0 9	0 8	0 6½	P
Thick		0 1¼	0 1¼	0 1⅛	0 1⅛	0 1	Q

DIMENSIONS OF ANCHORS.

	Frigates.		Sloop of War.	Denmark Yacht.	Bomb-Vessel.	Brigantine.	Brig-Cutter.	Cutter.	East India Ships.			West India Ships.			Packet.	Schooner.	Brig.	Sloop.
	GUNS 28	GUNS 24	GUNS 18	GUNS 10	GUNS 12	GUNS 10	GUNS 24	GUNS 16	TONS 1257	TONS 1000	TONS 818	TONS 544	TONS 440	TONS 330	TONS 201	TONS 133	TONS 170	TONS 60
	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
A	31 cwt.	29 cwt.	20 cwt.	19 cwt.	18 cwt.	14 cwt.	16 cwt.	15 cwt.	44 cwt.	40 cwt.	34 cwt.	29 cwt.	21 cwt.	18 cwt.	14 cwt.	8 cwt.	9 cwt.	7 cwt.
B	four	four	four	four	four	two	two	two	four	four	four	four	two	two	two	one	one	one
C	two	two	two	two	two	two	two	two	two	two	two	two	two	two	two	two	two	one
D	15 6	15 6	14 0	13 0	12 6	11 6	12 0	11 10	17 6	17 0	16 6	15 6	14 0	12 6	11 6	9 6	10 0	8 6
E	1 3½	1 3½	1 2	1 1	1 0½	0 11½	1 0	0 11¾	1 4½	1 4	1 4	1 3½	1 2	1 0½	0 11½	0 9½	0 10	0 8½
F	0 7¾	0 7½	0 7	0 6½	0 6¼	0 5¾	0 6	0 5⅞	0 8¾	0 8	0 8	0 7¾	0 7	0 6¼	0 5¾	0 4¾	0 5	0 4¾
G	0 1	0 1	0 1	0 1	0 0⅞	0 1	0 0⅞	0 0⅞	0 1	0 1	0 1	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞
H	0 1	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0⅞	0 0¾	0 0¾	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾
I	0 0½	0 0½	0 0½	0 0½	0 0½	0 0½	0 0½	0 0½	0 0⅝	0 0⅝	0 0⅝	0 0½	0 0½	0 0½	0 0½	0 0½	0 0½	0 0⅜
K	0 2¾	0 2¾	0 2¾	0 2½	0 2¾	0 2½	0 2½	0 2½	0 2¼	0 2¾	0 2¾	0 2½	0 2½	0 2½	0 2¼	0 2¼	0 2¼	0 2

SCANTLINGS OF BOATS.

	LAUNCHES.				BARGE.	PINNACES.				CUTTERS.				YAWLS.		WHERRY
	Feet 36	Feet 33	Feet 30	Feet 24	Feet 37	Feet 32	Feet 28	Feet 25	Feet 17	Feet 30	Feet 25	Feet 21	Feet 16	Feet 26	Feet 16	Feet 25
	ft. in	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
L	10 6	9 9	9 0	7 10	7 9	7 6	6 10	6 0	5 9	7 0	6 10	6 7	6 0	6 8	5 6	5 11
M	4 3	4 0	3 10	3 3	3 0	3 3	3 0	2 7	2 5	2 10	2 8	2 6	2 3	2 11	2 3½	2 4
N	5 0	4 9	4 6	3 9	3 10	4 0	3 8	3 2	2 11	3 8	3 3	3 1	2 9	3 6	2 9	3 0½
O	5 0	4 9	4 6	3 9	4 3	4 4	4 0	3 5	3 2	3 9	3 4	3 1	2 9	3 9	2 11	2 11½
P	0 7	0 6½	0 6	0 5½	0 4¼	0 4½	0 4	0 3¾	0 3½	0 4	0 3¾	0 3½	0 3	0 3¾	0 3¼	0 3¼
Q	0 5	0 5	0 5	0 4½	0 5	0 5	0 4½	0 4	0 4	0 4	0 3½	0 3¼	0 2¾	0 3	0 2¾	0 3½
R	0 0½	0 1¼	0 1¼	0 1	0 1	0 1	0 0⅞	0 0⅞	0 0¾	0 1	0 0⅞	0 0¾	0 0¾	0 0¾	0 0¾	0 0¾
S	0 5¼	0 5⅛	0 5	0 4¾	0 4	0 4	0 3¾	0 3½	0 3¼	0 3½	0 3¼	0 3	0 2¾	0 3¼	0 2¾	0 2½
T	0 5¼	0 5⅛	0 5	0 4½	0 3½	0 3¾	0 3½	0 3¼	0 3	0 5	0 4¾	0 4½	0 4	0 4½	0 4	0 3½
U	0 2¾	0 2½	0 2½	0 2	0 2½	0 2½	0 2½	0 2¼	0 2⅛	0 1½	0 1⅜	0 1¼	0 1¼	0 1¼	0 1⅛	0 1¼
X	9 0	8 3	7 6	6 6	4 9	4 7	4 0	3 6	3 0	3 3	3 1	2 10	2 4	3 8	2 7	1 6
Y	0 4	0 3¾	0 3½	0 3	0 2½	0 2½	0 2¼	0 2	0 1¾	0 1¾	0 1½	0 1½	0 1¼	0 1¾	0 1½	0 1½
Z	0 4	0 3¾	0 3½	0 3	iron	iron	iron	iron	iron	0 1¾	0 1½	0 1½	0 1¼	iron	iron	iron
A	0 5½	0 5¼	0 5	0 4¾	0 3¾	0 3½	0 3¼	0 3	0 2¾	0 3	0 2⅞	0 2¾	0 2½	0 2⅝	0 2¼	0 2¾
B	0 5½	0 5¼	0 5	0 4¾	0 3¼	0 3	0 2¾	0 2½	0 2⅜	0 2½	0 2½	0 2⅜	0 2	0 2¼	0 1¾	0 2¼
C	1 1	1 0	0 11	0 10	0 11½	0 11	0 10	0 9¼	0 8½	0 9	0 9	0 8½	0 7	0 8¾	0 7	0 8
D	0 6¼	0 6	0 5¾	0 5¼	0 3	0 2¾	0 2½	0 2¼	0 2	0 4	0 4	0 3¾	0 3	0 2	0 1½	0 3¼
E	0 4	0 3½	0 2¾	0 2¼	0 1¾	0 1¾	0 1⅝	0 1½	0 1⅜	0 1¾	0 1½	0 1⅜	0 1¼	0 1¾	0 1½	0 1
F	0 3¾	0 3½	0 2¾	0 2¼	0 1¾	0 1¾	0 1⅝	0 1⅜	0 1¼	0 1⅝	0 1¼	0 1¼	0 1⅛	0 1⅝	0 1½	0 1¼
G	0 6	0 5½	0 5	0 4½	0 4	0 4	0 3¾	0 3⅝	0 3½	0 3	0 2¾	0 2⅜	0 2	0 3½	0 3	0 2¾
H	0 4	0 3¾	0 3	0 2	0 1¾	0 1½	0 1½	0 1⅜	0 1¼	0 1½	0 1⅜	0 1¼	0 1⅛	0 1½	0 1¼	0 1
I	0 3½	0 3¼	0 2½	0 1½	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1¼	0 1⅛	0 1	0 0⅞	0 1¼	0 1⅛	0 1
K	0 3½	0 3¼	0 2½	0 1½	0 1¼	0 1¼	0 1¼	0 1¼	0 1⅛	0 1¼	0 1⅛	0 1	0 0⅞	0 1¼	0 1⅛	0 1
L	3 0	2 9	2 6	2 2	2 0	1 10	1 9	1 8	1 7	2 0	1 10	1 9	1 7	1 10	1 8	1 8
M	1 2	1 1	1 0	0 10	0 11	0 11	0 11	0 10½	0 10	0 10	0 9½	0 9½	0 8	0 10	0 9	0 10
N	0 3	0 2¾	0 2½	0 2	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1⅛	0 1¼	0 1⅛	0 1	0 0⅞	0 1⅛	0 1	0 1⅛
O	0 1½	0 1¼	0 1¼	0 1	0 0¾	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	0 0¾	0 0¾	0 0⅝	0 0¾	0 0¾	0 0¾
P	0 11	0 10	0 8½	0 7	0 4½	0 4½	0 4½	0 4⅛	0 4	0 4	0 4	0 3¾	0 3½	0 6	0 5	0 3½
Q	0 1	0 1¼	0 1⅛	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 1	0 1	0 0⅞

PARTICULARS, &c.		SPECIES. / LENGTHS.	LONG-BOATS. Feet 32	Feet 30	Feet 26	Feet 22	Feet 19	
			ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	
Thwarts	Main	*Broad*	1 0	0 11	0 11	0 10	0 10	A
		Thick	0 4	0 3¾	0 3½	0 3¼	0 3	B
	After	*Broad*	0 9	0 9	0 9	0 9	0 9	C
		Thick	0 2½	0 2½	0 2½	0 2¼	0 2	D
	Fore	*Broad*	0 10	0 10	0 10	0 10	0 10	E
		Thick	0 2¾	0 2¾	0 2¾	0 2½	0 2¼	F
	Loose	*Broad*	0 9	0 9	0 8	0 8	0 8	G
		Thick	0 2	0 2	0 2	0 1¾	0 1½	H
	Knees upon the thwarts, *sided*		0 3	0 3	0 2¾	0 2½	0 2¼	I
Benches	Broad		1 0	1 0	1 0	0 11	0 11	K
	Thick		0 1½	0 1½	0 1½	0 1¼	0 1¼	L
Deadwood	Sided		0 3½	0 3¼	0 2¾	0 2¼	0 2	M
Bottom	Thick		0 1⅛	0 1⅛	0 1⅛	0 1	0 0⅞	N
Landing Strake	Broad		0 11	0 10½	0 9½	0 9	0 8¾	O
Upper Strake	Broad		1 0	0 11½	0 10	0 9	0 8	P
Gunwale	Deep		0 3¾	0 3½	0 3	0 2½	0 2¼	Q
	Thick		0 4	0 3¾	0 3¼	0 2¾	0 2	R
Breasthook	Sided		0 3½	0 3	0 2½	0 2¼	0 2	S
	Length		4 6	4 2	3 6	3 3	2 10	T
	Moulded at the throat		0 7	0 6	0 5	0 4½	0 4	U
Ears	Sided		0 3¾	0 3½	0 3¼	0 3	0 2½	X
	Length		1 9	1 8	1 6	1 4	1 2	Y
Chocks	Thick		0 3¼	0 3	0 2¾	0 2½	0 2	Z
	Length		1 6	1 5	1 4	1 2	1 1	A
Washboards	Broad	Bow quarter	0 7	0 7	0 7	0 6	0 5¼	B
Bowsprit Step	Thick		0 3	0 3	0 2½	iron	iron	
	Broad		1 2½	1 2	1 0			
Windlass	Diameter		0 10	0 9½	0 9	0 8	0 7	C
Chocks	Thick		0 6	0 5½	0 5	0 4½	0 4	D
	Broad		0 11	0 11	0 10	0 9	0 9	E
Rudder	Breadth at the heel		2 0	1 10	1 8	1 7	1 6	F
	Breadth at the hance		1 4¼	1 3½	1 2	1 1	1 0½	G
	Breadth at the head		0 9	0 8½	0 8	0 7½	0 7	H
	Thickness		0 1½	0 1½	0 1½	0 1¼	0 1¼	I

	LAUNCHES.				BARGE.	PINNACES.				CUTTERS.				YAWLS.		WHERRY
	Feet 36	Feet 33	Feet 30	Feet 24	Feet 37	Feet 32	Feet 28	Feet 25	Feet 17	Feet 30	Feet 25	Feet 21	Feet 16	Feet 26	Feet 16	Feet 25
	ft. in.	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*	*ft. in.*
A	1 1	1 0	0 11	0 10	0 10	0 10	0 10	0 9½	0 9	0 10	0 9	0 8	0 7	0 10	0 9	0 9¼
B	0 4	0 3¾	0 3½	0 3¼	0 1½	0 1½	0 1½	0 1½	0 1½	0 1½	0 1½	0 1½	0 1⅜	0 1¾	0 1⅝	0 1¼
C	0 9	0 9	0 9	0 9	0 9	0 9	0 9	0 8½	0 8	0 8	0 8	0 8	0 7	0 7½	0 7	0 7½
D	0 2½	0 2½	0 2¼	0 2	0 1¾	0 1¾	0 1¾	0 1⅝	0 1½	0 1¾	0 1¾	0 1¾	0 1½	0 1½	0 1½	0 1¼
E	0 9	0 9	0 9	0 9	0 8	0 8	0 8	0 7½	0 7	0 10	0 10	0 10	0 9	0 7½	0 7	0 8½
F	0 2¼	0 2½	0 2¼	0 2	0 8½	0 8½	0 1½	0 1⅜	0 1⅜	0 2	0 2	0 2	0 1¾	0 1½	0 1½	0 1⅜
G	0 9	0 9	0 9	0 9	0 8	0 8	0 8	0 7½	0 7	0 8	0 8	0 8	0 7	0 7½	0 7	0 7½
H	0 2½	0 2½	0 2¼	0 2	0 1½	0 1½	0 1½	0 1⅜	0 1¼	0 1¾	0 1½	0 1½	0 1½	0 1½	0 1½	0 1¼
I	0 4	0 3¾	0 3½	0 3	*iron*	*iron*	*iron*	*iron*	*iron*	0 1¼	0 1⅛	0 1⅛	0 1	*iron*	*iron*	*iron*
K	1 0	1 0	1 0	1 0	1 0	1 0	0 11	0 11	0 10	1 0	0 11	0 11	0 10	0 11	0 10	1 0
L	0 1½	0 1½	0 1½	0 1½	0 1¼	0 1¼	0 1¼	0 1⅛	0 1⅛	0 1¼	0 1¼	0 1¼	0 1⅛	0 1¼	0 1⅛	0 1⅛
M	0 4½	0 4	0 3½	0 3	0 3	0 3	0 2¾	0 2½	0 2½	0 2¾	0 2½	0 2½	0 2	0 2¼	0 2	0 2
N	0 1½	0 1¼	0 1⅛	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0¾	0 0¾	0 0⅝	0 0⅝	0 0⅞	0 0⅞	0 0¾
O	0 11	0 10	0 9	0 8	0 6½	0 6½	0 6½	0 6½	0 5	0 5½	0 5	0 4½	0 4	0 8	0 7½	0 6
P	1 0	0 11	0 10	0 9	0 6½	0 6½	0 6½	0 6½	0 5½	0 6	0 6	0 5	0 4½	0 8	0 7½	0 6½
Q	0 4¼	0 4¼	0 3¼	0 3	0 3¾	0 3¾	0 3½	0 3½	0 3¼	0 2	0 1¾	0 1½	0 1½	0 2½	0 2¼	0 3¼
R	0 4	0 4	0 3½	0 3¼	0 1¾	0 1⅝	0 1½	0 1½	0 1½	0 2½	0 2¼	0 2	0 2	0 2	0 1¾	0 1½
S	0 4	0 4	0 3½	0 3	0 1¾	0 1¾	0 1½	0 1½	0 1⅜	0 2¼	0 2	0 1¾	0 1½	0 2	0 1¾	0 1½
T	5 0	4 3	3 9	3 0	2 6	2 4	2 2	2 0	1 8	1 9	1 8	1 7	1 6	2 4	2 2	2 0
U	0 10	0 9	0 7	0 5	0 4	0 4	0 4	0 3½	0 3	0 3½	0 3	0 2¾	0 2½	0 3½	0 3	0 3
X	0 4	0 3¾	0 3½	0 3	0 1¾	0 1¾	0 1⅝	0 1½	0 1½	0 1⅝	0 1½	0 1¼	0 1¼	0 2	0 1¾	0 1½
Y	2 0	1 10	1 9	1 6	0 11	0 10	0 10	0 10	0 10	1 4	1 2	0 11	0 9	1 0	0 11	0 10
Z	0 4½	0 3½	0 3	0 2½	0 1½	0 1½	0 1¼	0 1¼	0 1¼	0 1½	0 1¼	0 1¼	0 1¼	0 1¾	0 1½	0 1¼
A	3 0	2 9	1 4	1 2	1 2	1 2	1 1	1 0	0 11	1 3	1 2	1 0	0 11	1 1	1 0	0 11
B	0 6	0 6	{ 0 6	0 6	0 4½ 0 5½	0 4½ 0 5½	0 4½ 0 5½	0 4 0 5	0 3½ 0 4½ }	5 0	5 0	0 4¾	0 4½	{ 0 4½ 0 5½	0 4½ 0 5½	0 4½ 0 5½
C	0 11	0 10	0 9	0 8												
D	0 6½	0 6	0 5½	0 5												
E	1 3	1 2	1 0	0 11												
F	2 0	1 10	1 9	1 7	1 7	1 6	1 5	1 3	1 1	1 6	1 4	1 2½	1 1	1 5	1 3	1 3
G	1 6	1 4	1 3	1 1½	1 3	1 2	1 1	1 0	0 10	1 2	1 1	1 0	0 10	1 0½	0 11	0 11
H	0 10	0 9	0 9	0 8	0 9	0 8	0 7½	0 7½	0 7½	0 7	0 7	0 6½	0 6	0 7	0 6	0 5
I	0 1⅜	0 1½	0 1½	0 1½	0 1⅛	0 1	0 1	0 1	0 0⅞	0 1	0 1	0 0⅞	0 0⅞	0 0⅞	0 0⅞	0 0⅞

FORM OF A CONTRACT,

ENTERED INTO BY A MERCHANT-SHIP BUILDER,

FOR THE

BUILDING OF A SHIP OF WAR, FOR THE ROYAL NAVY:

INCLUDING THE DIMENSIONS, &C. OF

THE RAVEN BRIG, OF 18 *GUNS,*

BUILT IN THE YEAR 1804.

CONTRACTED and agreed upon the day of in the year of our Lord 1804, by and between , ship-builder, of the one part, and , being three of the principal Officers and Commissioners of his Majesty's Navy, (for and on behalf of his Majesty, his heirs, and successors,) of the other part, as follows, that is to say; FIRST, the said doth hereby, for himself, his heirs, executors, and administrators, covenant, contract, and engage, at his own costs, charges, and expences, to build in his yard, at , in a substantial and workmanlike manner, and with good, sound, and proper materials of every kind, (to be approved of by such officer or officers as shall from time to time be appointed by the principal Officers and Commissioners of his Majesty's Navy, for the time being, to superintend or inspect the same,) a Brigantine for his Majesty, to carry 16 carronades, 32 pounders, and two six pounder guns, agreeably to the draught delivered to him for that purpose, and in the manner, and according to the conditions, dimensions, and scantlings, following, *viz.*

LENGTH. On the main deck, from the aftside of the stem to the foreside of the stern post, 100 feet 0 inches. Of the keel, for tonnage, 77 feet $3\frac{1}{2}$ inches.

HEIGHT. Of the cutting-down in midships, $19\frac{1}{2}$ inches.

BREADTH EXTREME. From out to outside, of a three inches plank, above the wale, 30 feet 6 inches; moulded 30 feet, 0 inches; moulded, at the height of breadth, at the aftermost part of the counter, 17 feet $10\frac{1}{2}$ inches; moulded at the top timber line, or underside of the plank-sheer, in midships, 29 feet 6 inches; at the stern timber, 16 feet 9 inches.

DEPTH IN HOLD. From the upper side of the strake next the limbers to the upper side of the main-deck beam, at the middle, 12 feet 9 inches; strake next the limber-boards, thick 3 inches, broad 9 inches, distance from the keelson, 8 inches.

BURTHEN. In tons, 382$\frac{41}{94}$.

RAKE. Of the stem and stern post, to be agreeable to the draught.

HEIGHT. Of the main deck, from the upper side of the straight line, at the upper side of the main keel, to the upper side of the plank of the deck at the stem, 14 feet 7 inches; ditto at the stern post, 18 feet 3 inches.

Of breadth, above the upper side of the main-keel, in midships, 13 feet 7 inches.

Of the portsills, from the upper side of the upper deck to the upperside of the portsills, 16 inches. Of the waist, from the upper side of the keel to the under side of the plank-sheer—afore 20 feet; midships 19 feet; and abaft 22 feet $7\frac{1}{2}$ inches.

The Materials, Scantlings, Scarphings, &c. to be as follow: viz.

KEEL. The keel to be elm, not more than 4 pieces; sided, in midships, 11 inches; at the fore end, 10 inches; and, at the rabbets of the stern post, 10 inches; to be 12 inches deep; the scarphs to be 3 feet 0 inches in length, bolted with 6 bolts, of $\frac{7}{8}$ of an inch in diameter.

FALSE KEEL. To have a false keel, of elm, $5\frac{1}{2}$ inches in thickness; to have copper put between the main and false keels and the sides, and bottom thereof to be coppered, as shall be directed, and sufficiently fastened with nails and staples.

STEM. The stem to be in two pieces, of good sound oak timber; sided, at the head, 16 inches; at the deck, 11 inches; and, at the fore foot, the bigness of the keel; and moulded as described on the draught.

APRON. To be in thickness as described on the draught, and of breadth, at least 16 inches.

STERN POST. The stern post to run up and bolt to the upper deck transom, and as much higher as necessary; to be square, at the head, 13 inches; fore and aft, at the upper edge of the keel, 2 feet 4 inches; abaft the rabbet, at the wing transom, 9 inches; and the keel, one foot 9 inches.

INNER POST. The inner post to run up to the underside of the wing transom, and to be $7\frac{1}{2}$ inches fore and aft there, and $9\frac{1}{2}$ inches on the keel; to be the same athwartships, at the head, as the main-post.

FASHION PIECES. To be sided 11 inches; rabbetted, on the outside, to receive the plank of the bottom; and, on the aftside, to receive the plank of the tuck.

WING TRANSOM. The wing transom to round up $3\frac{1}{2}$ inches, and forward $6\frac{1}{2}$ inches, and square; and to be sided $9\frac{1}{2}$ inches, and moulded 14 inches, to be rabbetted on the aftside, to receive the plank of the tuck and plank of the counter; to have a knee at each end, sided 6 inches, the arms of sufficient length, and bolted as shall be directed.

RISING AND DEAD WOOD. The rising wood, or thick stuff, upon the keel, in midships, to be oak or elm, of 8 inches thick, and 13 inches broad: and of deadwood, afore and abaft, of a sufficient depth; on the lower piece of which is to be a knee, and another upon or under the keelson, as shewn on the draught; and the whole well fastened, at every 20 inches distance, by bolts of $1\frac{1}{8}$ inches diameter.

BOLLARD TIMBERS. To have proper bollard timbers, on each side the stem, for supporting the bowsprit; sided $9\frac{1}{2}$ inches, to cast or open sufficient to receive the diameter of the bowsprit.

ROOM AND SPACE. The room and space of the timbers 2 feet $4\frac{3}{8}$ inches full, or as the stantions of the frames on the draught.

FLOOR TIMBERS. The floor timbers to be of oak or elm, between D and C in midships, to be sided $9\frac{1}{2}$ inches; and, from thence forward and aft, 9 inches; and to be in length, in midships, 12 feet 0 inches; afore and abaft as the draught directs, and not to have less than 12 inches whole wood below the cutting down; and every floor timber to be bolted, with bolts of copper, through the keelson, and main keel, by bolts of $1\frac{1}{8}$ inches diameter; and all the bolts to be carefully clenched on the underside of the main keel before the false keel is put under. To be moulded at the heads $7\frac{1}{2}$ inches.

LOWER FUTTOCKS. To be oak or fir. The nine midship timbers to be sided $8\frac{3}{4}$ inches; and thence forward and aft 8 inches; to scarph to the second futtocks, in midships, 4 feet 10 inches; and afore and abaft as the draught directs; to be moulded at the head $6\frac{3}{4}$ inches. The lower futtocks, for the better dividing of the frame, are to be put between the floors so as to leave an equal opening on each side.

SECOND FUTTOCKS. To be oak or fir. Sided in midships 8 inches, and afore and abaft $7\frac{3}{4}$ inches. Moulded at the head $6\frac{1}{2}$ inches; to scarph to the third futtocks in midships 4 feet 10 inches.

THIRD FUTTOCKS. To be oak or fir. All those appointed to make the side of a port are to be oak, sided in midships 8 inches, and afore and abaft $7\frac{1}{2}$ inches; moulded at the heads $6\frac{1}{4}$; and to give scarph to the top timbers, in midships, 4 feet 10 inches; and, afore and abaft, as the draught directs.

TOP TIMBERS. To be oak or fir. The top timbers, in midships, sided 8 inches; and those that make the sides of ports to be oak, to be sided 8 inches, and afore and abaft $7\frac{1}{2}$ inches; and moulded at the head $5\frac{1}{2}$ inches; and, in the range of the deck, at the side, 6 inches.

FRAME. The whole of the port timbers are to be of oak; the other parts of the frame (except the floors) may be oak or fir; all the fir to be Riga or Dantzic of the very best quality.

HAWSE-PIECES. To have three hawse pieces, on each side; the foremost and aftermost to be sided $14\frac{1}{2}$ inches, and the middle one $14\frac{1}{2}$ inches; the hawse holes to be $10\frac{1}{2}$ inches diameter in the clear, after the lead scuppers are put in, and 11 inches asunder, the scuppers not to be less than $\frac{5}{8}$ of an inch thick at the lower part.

KEELSON. The keelson to be oak, 11 inches square, to give good shift to the scarphs of the keel, and bolted through every floor-timber, by bolts of $1\frac{1}{8}$ inches diameter; the scarphs to be 4 feet 8 inches long, wrought with hook and butt, and all the bolts carefully clenched under the main keel; and to have a knee upon the after end thereof, and as shewn on the draught; those bolts likewise to be copper.

WALES. To be oak or fir. To have 2 strakes of mainwales, of $4\frac{1}{2}$ inches thick, and 12 inches each in breadth, and to have one strake of $3\frac{1}{2}$ inches thick-stuff next upon, and one strake of $3\frac{1}{2}$ next under, the main wale; to diminish to 3 inches at the lower edge of the second strake; to be fastened with treenails.

PLANK OF THE BOTTOM. From the second strake next the wale, downwards, to be 3 inches fir plank, wrought carvel work, of regular breadths; not less than 6 feet shifts; to have a copper bolt in the winding edge of each strake, the bolts to be driven in the timber next the butt timber; to be fastened with treenails.

The openings between the timbers are to be fitted in, and caulked inside and out, from the floor-heads downwards.

To have copper bolts from the wales down; all above iron, of $\frac{3}{4}$ of an inch diameter; top-side, from the lower edge of the strake upon the wales, to diminish to two inches at the lower edge of the sheer strake; which is to work down to the ports in midships. The sheer strake to be 3 inches fir plank, and that both wales and stuff, upon and under that which covers the bottom, be good, sound, well seasoned, fir plank; free from sap, and all kind of defects.

PLANK SHEER. The plank sheer to be in thickness 3 inches, stuck with a moulding on the outside to form a rail.

THICK STUFF IN HOLD. To have one strake of 3 inches fir, 9 inches broad, and 8 inches from the keelson on each side, for a water-course to the pumps; with proper limber boards, &c. as usual.

FLOOR HEADS. To have one strake of $2\frac{1}{2}$ inches plank, and 9 inches broad, wrought on the joints of the timbers at the floor head; and one of 2 inches thick and 9 inches broad, above and below it; which three strakes may be reduced to two strakes, afore and abaft, of two inches thick.

FIRST FUTTOCK HEADS. To have one strake, of $2\frac{1}{2}$ inches thick and 9 inches broad, above and below it, which three strakes may be reduced to one afore and abaft $1\frac{1}{2}$ inches thick.

LOWER DECK CLAMPS. To have one strake of lower deck clamps on each side, 3 inches thick and 10 inches broad.*

PILLARS. The pillars in hold under the lower deck beams to be 7 inches square, at the lower end, and 6 inches at the upper end: the pillars under the upper deck to be $6\frac{1}{2}$ inches square at the lower end, and 6 inches at the upper end; those under the upper deck to be handsomely turned.

CLAMPS. The clamps to the main deck to be fir, in two strakes; the upper $3\frac{1}{2}$ inches thick, and 12 inches broad, the lower 3 inches thick and 10 inches broad: which two strakes may be reduced to one at the apron and fashion piece to 10 inches broad.

CEILING. All the rest of the ceiling, between the clamps and stuff at the floor heads, and from thence down, to be of $1\frac{1}{2}$ inches thick, well wrought and fastened, and to be all fir.

BREAST HOOKS. The deck-hook to be oak, sided $8\frac{1}{2}$ inches, and 11 feet 0 inches long; bolted with 7 bolts of $\frac{7}{8}$ of an inch diameter; and to have three breast hooks, under the deck-hook, of oak, well disposed, so as best to strengthen the bow; sided 8 inches, and not less than 8 feet in length; bolted the same as the deck breast-hook. All the breast-hooks and knee of the head to be fastened with copper bolts.

WORKS in HOLD, and on the PLATFORM and LOWER DECK. To fit proper steps for the main and foremast; lay a platform, with beams, &c. as shewn in the draught; the beams sided $8\frac{1}{2}$ inches, and moulded $6\frac{1}{2}$ inches. All the beams to be of fir, to be knee'd with one lodging knee at each end, of oak, sided $4\frac{1}{2}$ inches. To part off a well round the pumps, with a shot locker at the fore or aft part. To part off, and finish with joiner's work, on the platform, the cabins and bed places for the commander and other officers; and, also to part off, and make all such necessary conveniences, for bread, boatswain's, carpenter's, and gunner's stores, as shall be required and directed by the proper officer inspecting the same. Height from the plank of the lower deck to the upper deck beam, at the middle line, 5 feet 8 inches. Height of the after platform from the upper side of the plank, or deal, to the upper side of the upper deck beam, 6 feet 2 inches.

MAIN DECK BEAMS. The beams of the main deck to round 9 inches, in the greatest length; to be in number and disposed, as on the draught; to be sided 10 inches, and moulded $7\frac{3}{4}$ inches. The two after beams to be sided 9 inches, and moulded $6\frac{3}{4}$ inches; and all to be fir.

KNEES. The beams of the main deck to be knee'd at each end, with one hanging and one lodging knee, of oak; the hanging knee to be sided 6 inches; bolted with 8 bolts, of $\frac{7}{8}$ of an inch diameter; the up-and-down arm to be not less than 4 feet 0 inches, and the thwartship arm 3 feet; the lodging knee sided $5\frac{1}{2}$ inches; and the arms in proportion to the hanging, and as the room between the beams will require. The whole of the knees to be so well grown, that only the sap is to be taken from the throat, and great care is to be taken that they are not forced or grain cut. And, for the better securing the vessel by the knees, the thwartship arm of the hanging knees is to be bolted with four fore-and-aft bolts, with iron plates let in on both sides of the beam, to receive the second bolt from the crown of the knee and the toe bolt. All the in and out bolts to be flat or tool headed.

CARLINGS AND LEDGES. To have two tier of carlings on each side of the main deck, of fir, 6 inches broad and $5\frac{1}{2}$ inches deep; and ledges, properly placed, of $3\frac{3}{4}$ inches broad, and $3\frac{1}{4}$ inches deep.

COAMINGS. The coamings to all the hatches and scuttles, on the upper deck, to be at least 13 inches above the deck; and to be all fitted with close hatches or grating, as shall be required.

WATERWAYS AND FLAT. The waterways to be English oak plank, of 4 inches thick; one strake next them, and one strake on each side next the coamings, to be also of oak.

All the rest of the flat of the deck to be laid with well seasoned Prussia deals, of 3 inches thick.

PORTS. To have 9 ports on each side, for carronades, as also a bow and stern chase, as shewn on the draught; the sills from the deck 16 inches, to be fore and aft 2 feet 9 inches, and deep 2 feet 6 inches, to have two ring and two eye bolts to each port of $1\frac{1}{8}$ inch diameter, the rings $3\frac{1}{2}$ inches diameter, in the clear, and those on the deck $\frac{3}{4}$ of an inch diameter; and, also, for stoppers of $1\frac{1}{8}$ inches diameter; those through the side to be carefully clenched on a countersunk plate, and those through the deck to be carefully clenched under the beams.

SPIRKETTING. The spirketting on each side to be of fir, 3 inches thick, bolted with a $\frac{3}{4}$ inch bolt, in the timber next the butt.

STRING. To have a string wrought, fir, three inches thick, to work down to the ports in midships, and to be continued of that breadth fore and aft; to shut in between the string and spirketting, with 2 inch fir plank, the ends at the ports turned off with a quarter round, also the lower edge of the string, and upper edge of the spirketting.

BREAST-HOOK. Under the bowsprit, to be oak, sided $6\frac{1}{2}$ inches, the arms of sufficient length, and bolted with 7 or 8 bolts of $\frac{7}{8}$ of an inch diameter.

BITTS. To have a pair of riding bitts, of oak, as shewn on the draught and plans; square at the deck $10\frac{1}{2}$ inches, the cross-piece of the dimensions and height from the deck as shewn on the draught.

RIDERS. To have five riders on each side, of oak, three against the main, and two against the foremast, sided $9\frac{1}{2}$ inches.

CAPSTAN. To have a capstan placed as shewn on the draught, the diameter in the partners 14 inches, to be fitted with ribs and hoops at the partners, with 8 or 10 bars, chains, and two iron pauls on the deck.

SCUPPERS. To have 8 leaden scuppers on each side, 4 inches diameter in the clear, carefully let out and turned, that no leakage be found in the laps thereof.

MAIN AND FORE PARTNERS. The partners for the main and fore masts to be 6 inches thick, scored down one inch upon the beams, of 3 feet 8 inches in breadth, and sufficiently bolted.

TIMBER HEADS, &c. To fit timber heads for stoppers; catheads; bitts for jears; with chestrees and blocks; stopper bolts, on the flat of the deck and other parts, for rigging; and every thing that shall be required as necessary for an armed brigantine.

CHANNELS. To have channels for the main and foremast, as described on the draught, of oak; to be of sufficient breadth to carry the shrouds 12 inches clear of the hammock stantions; the inner edges of them to be 4 inches; the outer $3\frac{1}{2}$ inches; each channel to be bolted with 6 bolts of $\frac{3}{4}$ of an inch diameter; to have backstay stools as shall be directed.

DEAD EYES. To have, on each side, six dead eyes for the main channel, of 10 inches diameter; and five dead eyes on each side, of the same diameter, for the fore channels; with such others, to spare, for backstays, as shall be required; and fitted with chains and preventer plates as shewn on the draught: the bindings to be $1\frac{1}{8}$ inches diameter; those for the backstays $\frac{7}{8}$ of an inch diameter; the chain bolts to be $1\frac{1}{4}$ inches diameter; and the preventer bolts $1\frac{1}{8}$ inches diameter.

HORSE OR TAFFRAIL TRANSOM. To have a horse for the main sheet, of wood, made by the taffrail transom; sided $6\frac{1}{2}$ inches, and a block in the side for the fore sheet, with a transom knee wrought at each end, sided $4\frac{1}{2}$ inches; the arm next the lower side 5 feet 6 inches long, the other 4 feet 0 inches, long, bolted with bolts of $\frac{7}{8}$ of an inch diameter.

ROTHER. The rother-head to be athwartships 14 inches; fore and aft $14\frac{1}{2}$ inches; at the lower end to be fore and aft 3 feet 8 inches, on a square; the head to be well secured, with hoops and plates; fitted with a wood tiller of a proper length for steering the vessel. Bearded as shewn on the draught, the main piece to be of oak, and all the rest to be of fir.

STEERING WHEEL. To make and fix a proper steering wheel.

ROTHER IRONS. To have five pair of rother irons, fitted in the securest manner usual to vessels of her size; one pair of which to be above the deck, those under water to be of copper or mixt metal, as may be directed, and to be found by his Majesty, and whatever weight they may be, the value thereof is to be deducted from the contractor's bill, as in the case of the copper bolts.

COUNTER AND STERN. To have whole counter and stern timbers, properly placed to make the stern ports; with security for the ensign staff, transom for the main sheet, &c. properly knee'd, and other services required; and to have a neat plain taffrail and quarter pieces as usual.

HEAD. To have a small scroll head, with cheeks and rail as shewn on the draught; to be properly fastened, and as shall be directed. Knee of the head to be oak.

IRON WORK. That all the iron work shall be wrought out of the best iron, not burnt or hurt in working; and that all the bolts shall be either clinched or forelocked, and the rings let into the wood. N. B. The iron for the channels, ring and eye bolts for the ports, top tackle bolts, stopper bolts, or an additional iron work, which the commissioners of the navy may direct, is to be supplied by them, the said commissioners; and the amount to be deducted from the contractor's final bill, at the rate last paid to the contractor for iron, previous to its being delivered to them.

COPPER BOLTS. The copper bolts are to be found by his Majesty, and whatever the weight of them may be, the value of the same weight in iron is to be abated out of the contractor's bill, at the rate of one pound ten shillings per cwt. after deducting one sixth the weight of the copper, that difference being found to be in the weight of copper more than of iron of similar dimensions.

CAULKING. The vessel's sides and bottom to be carefully caulked, in every seam and butt of $4\frac{1}{2}$ inches, 6 double threads of black oakum, and 2 of spun yarn; and, in every seam and butt of 4 inches, 5 double threads of black oakum and 2 of spun yarn; and, in every seam and butt of 3 inches, 4 double threads of black oakum and one of spun yarn. All the black oakum to be picked out of good junk, and the whole to be good sound oakum; the spun yarn to be of proper size for the above purpose.

PAINTING. To treble paint or pay the bottom, with tar boiled to a strong consistence; to treble paint the vessel with good oil colours from the wales up, and within the spirketting, quick-work, bitts, companion, capstan, steering wheel, coamings, beams, knees, cabins, and clamps, with what else is usual to such vessels.

TIME OF LAUNCHING. And the said farther covenants, promises, contracts, and agrees, to and with the said principal officers of the navy, (parties hereto) that the said brigantine shall be completed, launched, and delivered safe afloat, into the hands of such officer or officers as, by the commissioners of his Majesty's navy, for the time being, shall be appointed to receive her, by or before the expiration of three calendar months, to be computed from the 29th May, 1804.

IF ORDERED TO STAND TO SEASON. It is agreed, by and between the said parties, that if the commissioners of his Majesty's navy, for the time being, shall think it expedient, when the frame of the said brig is completed, that it should stand still in order to season, the said , in that case, (upon notice thereof from the said commissioners) to cease all further progress, for and during the time mentioned in such notice; but to be allowed (in addition to the three calendar months before mentioned) as much further time for completing and delivering the said brig as aforesaid, as he shall be restrained by the said notice from prosecuting the works.

DEFECTS TO BE AMENDED. Provided also, that, if any materials or workmanship shall, by the officer or officers so to be appointed to inspect the same as aforesaid, be deemed defective, unsound, improper, or insufficient, then, and in such case, the said , from time to time, and as often as the same shall happen, is to cause all such defects and insufficiencies to be forthwith amended, or altered, as the case may require, to the satisfaction and good liking of the said officer or officers.

RATE PER TON. In consideration whereof, the said commissioners, (parties hereto) do hereby, for and on behalf of his Majesty, promise and agree, that the said shall be paid for the said brigantine, after the rate of nineteen pounds ten shillings for each ton; namely, for so many tons as the said brigantine shall measure, not exceeding 382 $\frac{4}{94}$ tons, but not for any greater number of tons, unless any increase of scantlings and dimensions shall be made in pursuance of an order in writing, under the hands of three or more of the principal officers and commissioners of his Majesty's navy for the time being; and such rate of tonnage is hereby declared and agreed to be the full and entire compensation and payment for the said brigantine, without any other charge, expence, or demand whatsoever.

PAYMENTS. The said rate, each ton, to be paid in manner and form following viz.

First.—A Bill of Imprest to be made out to for the sum of £1460 upon signing this contract.

Second.—Another for the sum of £1460 when the keel is laid, the floor timbers across, the stem and stern frame bends raised, the lower futtock cocked across, and the keelson bolted.

THIRD.—Another for the sum of £1460 more when all the timbers of the frame are in, the bottom planked, the wales about, the footwaling and clamps wrought, and the lower deck beams in their places.

FOURTH.—Another for the sum of £1460 more, when all the beams of the upper deck are in, the decks laid, the brig planked up within and without board, the works in hold finished, and the knee of the head up.

PERFECT BILL. And a perfect bill for the remainder that shall be due for the said brigantine, deducting therefrom the value of the weight in iron of the copper bolts, also the value of the iron as herein before directed; and, after she shall be entirely completed, launched, and delivered safe afloat, as aforesaid, into the hands of such officer or officers as shall be appointed to receive her, (and the draught and contract by which she was built returned to the Navy Office) and a certificate of the performance of the whole work, according to the tenor of this contract, made and given by such person or persons as shall be appointed by the said principal officers and commissioners. All which bills are to be paid in ninety days from their date, with interest thereon, at the rate of three pence per cent. per diem.

BILLS TO BE STOPPED. Provided always, nevertheless, and it is hereby agreed by and between the said parties, That, although Imprest Bills are herein before mentioned to be made out as the works of the said brigantine shall progressively go on, it shall and may be lawful to and for the commissioners of his Majesty's navy, for the time being, to stop such of the said bills as shall not happen to be assigned for payment, when and as often as it shall appear to the inspecting officer or officers, that any of the works of the said brigantine have not been executed or carried on, agreeably to the true intent and meaning of this contract.

IN CASE OF FAILURE. And, lastly, it is hereby also agreed, by and between the said parties, that if the said   shall fail or neglect to carry on and complete the said brigantine conformably to his engagement herein before mentioned, then, in such case, so much of the said brigantine as shall be done at the time of such failure or neglect, shall be the property of his Majesty, upon the said principal officers and commissioners of the navy, for the time being, paying for the same according to the usual value of such works, what shall be found to be due to the said   , after deducting the amount of such imprest bill or bills as shall have been made out and delivered to him pending the progress of the said works. And, in case of failure or neglect, it shall and may be lawful to and for the said commissioners, with workmen and others, to enter into the yard or dock where the said brigantine shall be building, and either to take away the said brigantine, or employ workmen to finish the same; and, for that purpose, to bring in all proper materials, and do all things necessary for completing the said brigantine; and, also, to launch the same, for his Majesty's use; without any molestation or hindrance whatsoever from the said

, his executors, administrators, or assigns, and without making any allowance or compensation, by way of rent or otherwise, for the use of the said yard or dock. In witness whereof, the said parties to these presents have hereunto interchangeably set their hands and seals, the day and year first before written or mentioned.

Sealed and delivered (being first duly stamped) in the presence of

Provided, nevertheless, that in case the said brigantine shall be completed and launched within the three months mentioned in the aforegoing contract, then the said commissioners do agree that the said shall be allowed a premium of five shillings per ton for every week she shall be completed and launched within the aforegoing three months; but it is to be understood, that no addition shall be made to the £19. 10. 0. per ton mentioned in the aforegoing contract, if she shall be completed and launched in less than one week within the aforesaid time.

INDEX TO THE TABLES

OF THE

PRINCIPAL DIMENSIONS AND SCANTLINGS.

EXPLANATION OF A FEW WORDS OMITTED, BY ACCIDENT, IN THE FIRST CHAPTER.

BAG OF THE HEAD RAILS. The hollow or lower part of the rails; or that part which lies nearest to a horizontal position.

BEAM-LINE. A line at the upper side of the deck at the side, which is, consequently, the upper side of the beam.

CAT'S TAIL. The inner part of the cat-head, especially of a large ship having a beak-head.

CROSS-BORED. Having holes bored alternately, as on the edges of planks, &c., to separate the fastenings so as to avoid splitting the timbers or beams.

FLY-UP. A term synonymous with *Flight;* signifying a sudden deviation upwards from a sheer-line, as the clamps of the lower deck *fly-up* abaft to prevent a great sny, &c.

FOXEY. A defect in timber, of a reddish cast or hue, proceeding from over-age, &c.

HAND-TAUGHT. So tight as may be fixed and removed by the hand, without mechanical assistance.

PLATFORMS. The lowest decks in a ship, and those which do not run throughout the ship's length. They are consequently framed more lightly than the other decks.

QUOIF. The waterway forward, wrought about five feet on each side the middle, in one piece; so avoiding a butt in the middle line.

SLIDING BATTEN. A narrow batten made so as to slide lengthways, and to be extended for taking lengths of beams, &c.

SPLITTING BLOCKS. Generally the upper blocks placed in the slip beneath the false-keel after it is fitted. They should be of oak, of the freest grain, that they may be the more easily split away prior to launching.

THROUGH-CHOCKS. When timbers of the frame are converted short of their length, the chock must be worked through to make good the deficiency; and the chock so worked is called a *Through-chock*.

TONGUE. A narrow tapering piece worked in to make good any deficiency, &c.

UP AND DOWN. Perpendicular, or nearly so: as the side arm of hanging-knees is called the *up and down* arm.

WINDING BOARD. A board whereon the windings or bevellings of any timber, &c. are described; but, more especially, the windings of the side counter or stern timber.

ERRATA.

Page 5, For BALLUSTERS, read BALUSTERS; and, in the same article, for *round*, read *along*, *or in front of*.
—— 9, Article BOATS, for plate 23, read 29.
—— 17, Article CHASE; erase the words *chased about*, &c.
—— 32, line 6, read *stem*.
—— 91, — 15, for *o*, read *of*.
——108, erase the §.
——155, line 20, for *spight* read *spite*; and, in line 14 from the bottom, for *dock* read *deck*.
——260, line 1, for *to* set off, read *so* set off.
——261, — 16, erase the words *therefore set off their diameter between the cheeks*.
——262, line 14, for *upper deck hook and the heel, and scarphs*, read *upper deck hook, and the heel scarphs*.
——264, Add to line 24, Lately we have been obliged, from necessity, to have the timbers somewhat short, and the length made good by scarphing a piece on the head or upper part; but they should always be made to run up above the regular shift.
——265, line 1, prefix § 5.
——274 and 275. The particular referred to in the 9th line to Plate 35, fig. 1; and that in the 6th line of Page 275, to Plate 35, fig. 2; are, it is to be observed, considered as only drawn in pencil, as they would otherwise interfere too much with the rest of the work.
Page 277, line 18, for *faces quarter inch and a half*, read *faces one inch and a quarter or one inch and a half*.
——290, — 14, for strike up *perpendiculars*, read *perpendicular*.
——305, — 14 from the bottom, read, Toptimber moulds are the same.
——308, — 8 & 7 from the bottom, for STERN read STEM.
——309, — 2, for *stern* read *stem*.
——313, lines 3, 7, 9, 14, 21, 28, 36, for cant-timber *u*, read cant-timber *w*.
——317, line 2, for *Keelson* read *Deadwood*.
——334, — 22, for *in the same* read *in the same manner*.
——341, — 16 from the bottom, for *dec*. read *&c*.
——343, — 13 from the bottom, for *at* read *as*.
——344, — 6, for *above*, read *about*.
——365, — 6 from the bottom, for *found* read *formed*.
——394, — 3, for greatest *descending* read greatest *ascending*. In the next line, for second *descending* read second *ascending*.
——424, first column of figures, against *mean* square, for 1 *ft*. 9 *in*. read 1 *ft*. 1 *in*.

IN THE TABLES.

Page 20, Fore Body of an East-India ship. Against Height of the cutting down line, Timbers O, 8, U, X, read 2 ft. 10 in.; 4 ft. 1 in.; 5 ft. 6 in.; 0 0. And, against Height of the cutting line, Timbers O, S, read 3 ft. 0 in.; 4 ft. 8 in.

Folio VII. line 1, for COUNTER TIMBERS read KELSONS.

Folio XV. line 22, for *trance* read *hance*.

Folio LVI. 9th line from bottom, for *stern* read *stem*.

In the DIMENSIONS of the FRIGATE of 38 GUNS, according to the latest class, the following corrections are required. In this instance it is to be understood, that we count the lines from the head of the Table, *under the title* 38 *guns*, assuming the line *ft. in.* as the *first* line.

The computed load-draught of water of this ship is, Afore, 17 8; Abaft, 19 2. Ditto, when actually fitted for sea, 17 11; 20 2.

In Folio II. line 12, for 19 6 read 18 2; line 13, for 19 9 read 18 3½; line 14, for 30 9 read 29 9.

In Folio III. line 16, for 2 7 read 2 9; line 18, for 0 10 read 1 0; line 19, for 4 4 read 5 6; line 20, for 1 7½ read 2 3; line 21, for 1 9 read 1 11.

In Folio IV. line 4, for 22 1 read 22 0; line 6, for 0 6 read 0 10; line 7, for 0 4 read 0 3; line 8, for 25 0 read 26 0.

In Folio V. line 12, for 2 4⅞ read 2 6 13-27ths.

In Folio VII. line 13, for 20 3 read 18 6; line 14, for 16 9 read 16 6; line 15, for 20 9 read 20 5.

In Folio VIII. line 15, for 5 2 read 5 1; bottom line, insert 61 0.

In Folio IX. insert, against the first line of figures, 58 9.

In Folio XV. line 15, for 34 9 read 38 6; line 16, for 17 0 read 22 9; line 21, for 6 3 read 5 8.

In Folio XVI. line 2, for 12 0 read 16 0; line 29, for 5 0 read 5 6.

In Folio XVII. line 16, insert foremost bulkhead afore the after perpendicular, 30 8; line 17, for 7 6 read 10 0.

In Folio XVIII. line 3, insert *none*; line 6, for 5 6 read 14 0.

In Folio XIX. line 11, for 17 2 read 16 10; and the figures in the 7 lines immediately after to stand thus;—16 2; 18 2; 0 3; 6 4; 6 4; 6 4; 0 5.

In Folio XX. line 4, for 27 read 26; line 35, for 15 6 read 19 4; and the figures in the 6 lines immediately after to stand thus;—0 0¾; 87 3; 0 0¼; 22 0; 0 0¾; 1 1.

In Folio XXI. line 40, for 7 6 read 7 0; and the figures in the 6 lines immediately after to stand thus;—4 0; 4 0; 4 8; 4 8; 24 6; 5 2.

In Folio XXII. line 2, for 4 6 read 5 10; line 3, for 2 4 read 2 8.

In Folio XXIII. line 12, for 18 9 read 22 6; line 14, for 16 0 read 16 6.

In Folio XXXI. last line, for 0 7 read 0 9.

In Folio XXXIII. line 13, for 3 9 read 5 0; line 16, for 8 6 read 5 6; line 18, for 25 0 read 30 8.

In Folio XXXVIII. line 10, for 21 0 read 24 4.

In Folio XLII. line 3, for 0 11 read 0 9; line 7, for *four* read *eight*; line 9, for 2 7 read 3 4; line 11, for 70 0 read 79 0.

In Folio XLVI. line 11, for 37 3 read 40 0.

In Folio XLVIII. line 10, for 11 6 read 11 0; and the figures in the 7 lines immediately after to stand thus;—12 8; 2 3; 21 7; 27 10; 27 9; 31 10; 31 6.

In Folio XLIX. line 9, for 1 9 read 1 10; line 51, for 6 0 read 6 8.

In Folio LII. line 20, for 3 6 read 3 5; line 21, for 4 9 read 5 2.

In Folio LIV. line 8, for *ten* read *eleven*; line 12, for *two* read *none*; line 19, for 2 2 read 3 3; line 24, for *five* read *six*; line 27, for 2 2 read *none*.

In Folio LV. line 35, for 29 6 read 29 7; and the figures in the 4 lines immediately after to stand thus;—27 6; 32 4; 2 0; *but none used*.

In Folio LVI. line 2, for 9 0 read *none*; line 3, insert 20 4; next line, insert 4 3 *afore the centre*; line 12, insert *none*;

FINIS.

WHITTINGHAM, Printer, Dean Street, Fetter Lane.

AN

APPENDIX,

CONTAINING THE PRINCIPLES AND PRACTICE OF

CONSTRUCTING SHIPS,

AS INVENTED AND INTRODUCED

BY SIR ROBERT SEPPINGS, SURVEYOR OF HIS MAJESTY'S NAVY.

BY JOHN KNOWLES, F.R.S.,

SECRETARY TO THE COMMITTEE OF SURVEYORS
OF HIS MAJESTY'S NAVY.

TO

SIR ROBERT SEPPINGS, KNT., F.R.S. M.R.I.,

SURVEYOR OF HIS MAJESTY'S NAVY,
HONORARY MEMBER OF THE CAMBRIDGE PHILOSOPHICAL SOCIETY, &c. &c. &c.

DEAR SIR,

I ACKNOWLEDGE my presumption in sending to the world, under the sanction of your name, this small Work, on the mode of building Ships, invented by you, and now generally practised in His Majesty's Navy.

Although you cannot but be sensible, that there are many errors in this attempt of mine, to explain a system which has, for the last twenty years, cost you so much of deep thought, anxiety, and labour; yet I am sure you will look upon it with a favourable eye, and rightly appreciate the desire to be useful,—an example which you have daily and for several years held up to him, who has the pleasure to subscribe himself,

Dear Sir,

Your very sincere Friend,

and very obliged and devoted Servant,

JOHN KNOWLES.

Navy-Office, Jan. 1, 1822.

THE

PRINCIPLES AND PRACTICE

OF CONSTRUCTING THE

ROYAL AND MERCANTILE NAVIES.

SECTION I.

AN HISTORIC AND DESCRIPTIVE ACCOUNT OF THE DIAGONAL METHODS OF BUILDING SHIPS.

WHEN we contemplate the proudest effort of naval architecture, a three-decked ship of war, and consider all the appertenances for battle and conveniencies for her numerous crew, consisting generally of nine hundred men, we are struck with the magnitude, the beauty, and fitness of the structure; and the mind turns to a consideration of the gradual increase and improvements which have been made from the simple punts or pontoons of our ancestors, to bring a first rate ship to its present state of perfection.

If we may believe the evidence of history, ships of extraordinary large dimensions have been built by the ancients; these were either for the purposes of parade, or the removal of some ponderous monument of art; for as navigation was then in its infancy, and their vessels chiefly employed in coasting, these unwieldy ships, which necessarily must have had a considerable draught of water, were ill adapted to extensively useful purposes. The important discovery of that invaluable instrument the compass, at the beginning of the fourteenth century, by Flavio John de Gioja, a native of Amalfi, in the kingdom of Naples, not only gave an energy to navigation, but also to naval construction, by enabling mariners to put fearlessly to sea and visit other nations in ships of enlarged dimensions; and thus added to the luxuries and conveniencies of life, by the interchange of commodities the produce of different countries. This period may almost be termed the birth of naval science.

From the earliest efforts of naval architects to within a few years, little was done to render ships stronger, by a different combination or adaptation of the materials of which they are composed, or to attain that, which is so much to be desired in architectural works, a *maximum* of strength with a *minimum* of materials. The timbers of ships, or, as they are sometimes called, ribs, were placed vertically; and the planking, or, as it has frequently been named, skinning, horizontally; and these, with very slender modifications, have been the practice at all times and of all countries. Some alteration, however, has always been acknowledged to be necessary, that the strains to which the materials are subjected might be supported by their longitudinal strength in resisting the compression or extension of their fibres, in which direction they are the strongest, instead of being acted upon laterally; and, accordingly, attempts have been made from time to time to improve the system, by placing some of the materials in a diagonal direction. But it appears, that no sooner were these carried into effect, than they were severally abandoned, chiefly, as it is said, from the want of proper abutments; and it was not until the year 1810, that the placing of materials in a diagonal direction to strengthen ships, was brought to any perfection; when Mr. (now Sir Robert) Seppings, introduced a plan of a diagonal framing, formed by riders, (or as they are considered, braces) and trusses. This plan was first carried into effect in His Majesty's Ship Tremendous*, and subsequently into all ships of the line in the British Navy; the consideration of which, and the manner of carrying it into execution, will form the subject of this work.

As all arts and sciences have their infancy, and gradually advance to maturity, so the plan, as practised upon the Tremendous, was preceded by partial introductions of the system. In the year 1800, Sir Robert Seppings, in the repair of the Glenmore of 36 guns, an old and weak frigate built of fir, laid some planks in her hold crossing the footwaling in a diagonal direction, in order that they might act as ties to strengthen the ship. The success that attended this experiment induced him to extend the system; and in 1805, when the Kent of 74 guns, a ship of large dimensions, was docked for repair at Chatham, it was found that she was in a general state of weakness, for an alteration had taken place from her original sheer, or she had arched in each half of her length, no less than seventeen inches. As a partial remedy, Sir Robert placed between the bends

* Before the plan of building or repairing of ships with diagonal braces and trusses was carried into effect, on the Tremendous, the Right Honourable Charles Yorke being then First Lord of the Admiralty, formed a Committee of the most celebrated mathematicians and naval and civil architects in this country, for the examination of the system, and it was from the favourable opinion given by them, that this method was adopted.

of vertical riders already in the hold, diagonal ones, lying at an angle of forty-five degrees; and abutting against them and the original riders, trusses, at the same angle in an opposite direction: this framing was found in a great measure to preserve the sheer of the ship. It will be perceived, by the description which will be given, that this was an approximation to the perfection of the plan, as practised on the Tremendous, and which has been followed, with slender modifications, from the year 1810 until the present time.

When the diagonal mode of shipbuilding was first brought forward to public notice, it was pronounced by some, to be "without sense or science," while others, either from envy or an inaptitude to bring their minds to examine new combinations, predicted no less than the loss of the ships that might be built thereby, if they proceeded to sea; or speedy decay if they were laid up in harbours. When it was carried into effect, and success crowned the effort, the originality of the idea was claimed by several in this country, upon no better pretence than that they had proposed to lay some materials in a diagonal direction, or that they had thrown out the idea in some written or printed document. Foreigners have also claimed for their countrymen the merit of the plan; but before their pretensions are examined, it will be right to give a succinct description of this method of ship-building as now practised in His Majesty's Dock-yards.

If a ship, like any work of civil architecture, were always at rest, it would be easy to measure the forces that act upon the several parts, and apply the materials in such quantities, and in such directions, as should in the most effectual manner resist them. But as this is not the case, the naval architect has to provide against forces acting in all directions, by the pressure of the water, the impulse of the wind and waves, and the momentum of the body acted upon by them; from these an alteration in figure generally takes place, and ships have a disposition first to arch (or hog, as it is sometimes called,) longitudinally by curving upwards in the middle in the direction of their length. Hogging is sometimes the effect of a faulty construction, but is generally brought about by the unequal distribution of the weights placed in different sections of the body; when compared with the quantity of water displaced at those places, and from the fore and after parts of ships being frequently left unsupported by the water during the motions of pitching; to these may be added, the stress of the masts downwards, not only by their own weight and that of the rigging, sails, *&c.*, but by the pull of the shrouds, and also the pressure of water upwards, on those floors which lie in nearly a horizontal position.

A transverse alteration or separation of the parts composing a ship is brought about by the pressure of the water against the bottom, the tendency which the beams have to pull in the one side and force out the other when a ship is going on a wind, and lies over under a press of sail, at angles of inclination varying according to the relative forces exerted by the sails on the masts, or from the motions of easy or uneasy rolling, and particularly from the latter, which is termed jerking.

To place the materials so as to oppose the greatest and most perfect resistance to longitudinal and transverse alterations in form, is the object then of the new mode of ship-building.

The timbers composing the frames are put together with square heads and heels*, having coaks introduced therein, *(Plate N. fig. 4. I.)*, so as to make the union of the head of one timber with the heel of the other more perfect; and the timbers throughout the ships are all formed into frame bends. When the ships are completed in their frames, and have remained in that state a sufficient time for the materials to season, pieces of dry wood about three inches in thickness are tightly driven from the outside in each opening between the timbers, and upon this, cement is placed, formed of two parts of Parker's cement and one of drift sand; and, in order to economize this mixture, bricks are put into the openings that are wide enough to receive them; other pieces of wood of about three inches in thickness are then driven from the inside, so that the frame by these means is made one solid mass from the keel to within a few inches of the orlop clamps; the pieces of wood so placed are then dubbed fair, to correspond with the outer and inner surfaces of the frames, and the joints are caulked both within and without.

From the orlop clamps downwards the inner lining, usually called ceiling or foot-waling, is omitted, and a framing is worked, consisting of braces or riders *(Plate K. fig. 1. B.)* lying at an angle of forty-five degrees, thick pieces placed between them horizontally over the joints of the timbers, *(Plate K. fig. 1. C,)*, and trusses lying at an angle of forty-five degrees between the thick pieces and riders,

* The practice of cutting scarphs at the heads and heels of timbers, for the introduction of chocks, under the notion, that an economical conversion of the pieces of timber was effected thereby, was introduced into His Majesty's service about the year 1714, and was generally followed in the British Navy until the year 1818. During a period of more than a century, this method was confined to British ships.

(Plate K. fig. 1. *D.)*, which altogether form a series of triangles; the triangle being the most immoveable figure known, the framing so formed is attached to the timbers of the ship by coaks and bolts. This, with diagonal trusses worked between the ports *(Plate K. fig.* 1. *G.)* instead of the horizontal planks called short-stuff, are intended to prevent arching.

The two additional keelsons, *(Plate K. fig.* 1. *A.)*, which are worked in midships, serve to counteract the force exerted by the mainmast downwards, and the pressure of the water tending to force upwards those floors which lie in nearly a horizontal position.

The introduction of shelf pieces, or internal horizontal hoops, on which the beams rest, *(Plate K. fig.* 1. *a.)*, and to which they are attached by coaks, the thick waterways which are scored down on the beams, and coaked to them, having bolts which pass through the waterways, beams, and shelf-pieces, and being attached in a contrary direction by bolts passing through the waterways, shelf-pieces, clamps, and the sides of the ships, not only do the office of lodging knees, and tend to prevent an horizontal curvature, but also a transverse separation of the several parts; the junction of the beams to the sides of the ships for the latter purpose, is also made more perfect, by a chock on which the shelf-pieces rest, to the front of which, the up and down arm of an iron knee is bolted,—this knee has also two other arms which clasp the beam, and to which it is attached by three bolts driven in a horizontal direction, with one up and down bolt in the throat of the knee through the beam. The general attachment of beam to beam is brought about, by thick strakes scored into the beams, carlings at the ship's sides on which the diagonal decks are fastened, and others lying also between the beams and half-beams, but at an angle of forty-five degrees; which, with the beams, and the diagonal direction in which the planks of the decks are laid, Fig. 2, form again a series of triangles. It will be seen by this description, that the general principle of the new mode of ship-building is the substitution of the triangle for the rectangle. The beakheads in ships are discontinued, and the timbers in the bows run up to the top of their sides, which forms a round bow; a plan which had been long practised in frigates, and was proposed by Sir Robert Seppings in the year 1807, to be carried into effect in ships of the line. The suggestion arose, in consequence of the great number of men who were killed or wounded on the upper deck of the Victory of 100 guns, at the battle of Trafalgar, by the grape and other small shot passing through the thin boarding of the beakhead bulkhead, as that ship passed down, in order to break the line of battle of the French fleet. This alteration not only increases the strength and safety, but conduces also to the symmetry of the ships.

The sterns are also formed circular, and to add to their strength, as many timbers as possible are run up: this presents a very formidable stern-battery; enables the guns to be run out so far as to prevent accidents to the stern by their explosion; the danger arising from being pooped is considerably diminished, if not wholly prevented; and the obstruction to the ship's progress, which, according to the old plan was occasioned by the projection of quarter-galleries, when the ships were going on a wind, is removed. In fine, by this alteration, the ships are every way more seaworthy, and better adapted for defence; qualities which are so essential and indeed indispensable in ships of war *.

The first attack of those who were inimical to this system was made by their asserting, that, the ships would lose a considerable degree of strength by the omission of the footwaling, and therefore become dangerous at sea. This opinion was given, without adverting to the considerations, that, independently of the diagonal framing, a very great degree of fixedness, and consequently strength, is gained, by filling in the frame, which must be abundantly more than could possibly arise from the ceiling, the edges of which were never in contact, nor was it the practice to caulk the seams. And with respect to safety, if the planks of the bottom were removed by striking on a rock or grounding, the ships would still swim; for, by filling in the frame of a ship of the line of 74 guns nearly as high as the orlop, there is a solid substance twelve inches through, independently of the plank of the bottom which is four inches in thickness.

It was next asserted, that the filling in the interstices between the frame timbers, would subject the ships to premature decay; and

* Dans la pouppe ronde Anglaise, telle qu'on l'exécute aujourd'hui pour les vaisseaux à trois ponts, la dunette et le gaillard d'arrière, réservés pour le capitaine et pour l'amiral, ont un balcon en fer très-léger formant galerie extérieure. C'est le seul ornement de l'arrière. Des bouteilles aussi petites que possible, sont placées au centre des trois rangées de sabords battant sur l'arrière de la pouppe.

Tout ce système a l'air bien pauvre et bien léger, sans doute, en comparaison de nos belles pouppes bien enhuchées! avec de belles bouteilles bien massives!! et de belles galeries à sculptures bien grossières!!! Cependant, lorsque l'œil du spectateur n'est pas ennemi de la simplicité, du naturel et des convenances, il finit par trouver les pouppes rondes, avec leur aspect vraiment militaire, plus imposantes et plus belles encore, que tout cet échafaudage à colifichets, qui donne à l'arrière d'un vaisseau l'air d'une boutique des boulevards.——Ch. Dupin.—*Force Navale de la Grande Bretagne.* Tome II.—*Etude et Travaux,* Chap. 3.

instances were adduced which were considered analogous, *viz.*, that the frames filled in, in wake of the channels, and that those in the fore and after bodies, where the frame timbers nearly touch, are more subject to rottenness than any other parts of the ships. Those, however, who made use of these arguments had lost sight of the well-known fact, that "when excluded from the air, even moist "wood shews but little tendency to decomposition;" and in giving the instances which they brought forward in support of their opinion, they had not considered that the decay of the timbers in the vicinity of the channels is brought about by the continual introduction of air and moisture, through the many holes made for the reception of the bolts which attach the chain and preventer plates to the sides of the ships, and which, from the great stress upon those fastenings by the masts, constantly leak; and that the frames in the fore and after bodies of ships are subject to early decay, from the circumstance of their being more cut across the grain of the wood from their form, than those are in midships; and the consequence of being so nearly in contact is, that the air, (which cannot circulate), suffers deterioration, and hence becomes an active agent to bring about the decomposition of the timber.

There is the sure test, experience, to prove the good effects, as far as the durability of the ships and benefit to the health of the seamen are concerned, which arise from the new method of ship-building, and particularly from the ships having solid bottoms. When the Tremendous was repaired at Chatham in the year 1815, after five years of very active service, she was found to be perfectly sound where filled in, but to have many defective timbers above the orlop clamps, and no complaint has been made of the want of durability in any one of the very many ships which have been built or repaired according to this method. Sir Gilbert Blane, in his *Treatise on the Health of the Navy*, has forcibly proved, that the seamen on the same stations, employed in ships built according to Sir Robert Seppings's principle, were decidedly more healthy than those who were on board the ships constructed according to the old method, and this he attributes to their very dry state from having solid bottoms: much as dryness, no doubt, conduces to the health of the seamen and to the preservation of the hulls of the ships, their provisions and stores; yet there is reason to believe, that the more perfect ventilation which is constantly going on by means of the openings between the frame timbers, which are, by the introduction of shelf-pieces made channels to convey air between decks, has also been the means of contributing to the health of the crews. Added to which, as the ships, from their great strength and fixedness*, are not subject to leaks, the effluvia arising from bilge-water is prevented, as well as that from filth, which used to accumulate in the hold in the openings between the frame timbers.

When the new plan of ship-building was first submitted to the attention of the government, it was considered by some persons of

* A notion has been very generally current, that the strength or rigidity of a ship destroys her sailing properties, and hence it was supposed that the ships built according to Sir Robert Seppings's principle would be dull sailers; facts have, however, proved that this opinion is erroneous. It can be easily understood how a ship, the form of which was originally very bad, may be benefitted by any alteration; and how, therefore, a vessel which, when new and strong, sailed very indifferently, improved in that quality when she became old and weak. But it is not so easy to comprehend how a ship, constructed upon the best principles for dividing the fluid easily, and to give the required quantity of stability, should be improved by weakness, or by a continual change of form according to the relative pressure of the wind upon the sails.

high mathematical talents, (but who generally approved of it,) that the riders and trusses were incorrectly disposed. According to the present system, the riders are pulled, and the trusses pressed upon, in the direction of their fibres, by the disposition which the ships have to arch *; but according to their views of the subject, the riders should have been placed in the direction, and done the office of the trusses, and the trusses that of the riders. This at the time caused much discussion ; and as the subject in defence of the present disposition, has not been better handled than in the following paper, †, and their correct disposition being of much importance, its insertion will no doubt be acceptable to the reader.

" By the arching of a ship is meant, the middle of the ship's length " rising, and the ends falling, which is occasioned by the inequality " of the weights (comprising the ship and lading), and the vertical " pressure of the water in the different parts of the ship. The " inequality is apparent, if we only consider the great weights at " the extremities of the ship, and the small support by the vertical " pressure of the water in those parts, from the body tapering at " the extremities. The longitudinal pressure of the water, on the " ends of a ship, has also a tendency to produce arching. The " latter cause may be illustrated by the partial pressure on a piece " of Indian rubber: supposing the Figure A. B. C. D. (*Plate* L, " *Fig.* 1.) to represent the Indian rubber before the pressure, and

* It has been justly remarked, that the arching of ships does not arise so much from the want of strength of the materials, as upon their play upon each other.—See *Don George Juan*, Book II. chap. ix.

† This was written by Mr. Wm. Morgan, Student in Naval Architecture, but never printed ; and he obligingly favoured the Author with his permission to publish it.

" that it receives a pressure on the parts A. E. and D. F., this will " cause it to assume the form in Figure 2."

" To counteract the action of these two forces, but especially the " former (as the fillings between the timbers, extending nearly to the " height of the action of this force, present a firm resistance to the " latter) is the effect which is intended by the diagonal framing. " The diagonal framing is disposed as represented in Fig. 3. The " longest pieces of timber, the riders or braces, are laid in the fore " body inclined aft, as AB, CD; and in the after body inclined " forward, as EB, FG. Longitudinal pieces are laid between the " braces as HK, LM, dividing the spaces between the braces into " rhomboids. Truss-pieces are introduced into these rhomboids in " the direction of diagonals, in the fore body inclined forward as " HN, KO, and in the after body inclined aft, as MP, LZ.

" Let RN, KH, and NOSK, (Fig. 4,) represent two of the " rhomboids in the fore body—suppose AB to be the neutral line " of the ship, from which it arches forward and aft. By arching, " the lines AE and BF, supposed in the figure to be straight lines, " become curvilinear as AC and BD. Supposing these curves to " be arcs of circles, AC is an arc of a circle of a greater radius than " BD. Taking AP=AO, the point O would fall into the point P; " but this cannot take place, because taking BQ=BK, the point " K would, by the arching, fall into Q; but KQ is evidently shorter " than OP, being nearer to the neutral line, and therefore PQ " shorter than OK; so that the arching is prevented by the resist- " ance the truss-pieces present to compression in their lengths. In " the same manner the trusses act in all the rhomboids to prevent " the ship's arching, extending from the neutral line forward and aft.

"The effect of the braces is similar: the point K in the brace "N K P cannot fall into the point Q because N V is shorter than "K Q, and therefore V Q is longer than N K, so that the arching "is prevented by the resistance the braces present to extension in "their lengths. In the same manner the support of the braces "is extended forward and aft from the neutral line. The support "given by the trusses is by the strength of their fibres; but by the "braces by the strength of their fastenings.

"It is thus seen, that the mechanical advantage of the trusses and "braces would be equal, if the arcs A C and B D were arcs of "equal circles, considered independently of the different manner "in which they sustain the strain. But the arc A C, being the arc "of a circle of a greater radius than the arc B D, the depression of "B D below the straight line B F is greater than the depression "of A C at an equal distance from A B below A E, consequently "the excess of O P above K Q is diminished; but the excess of K Q "above N V is increased. The arching of the ship would there-"fore tend to compress the length of the truss K O less than it "would expand the brace *o k*; so that if either braces or trusses "were used separately, braces would theoretically be more advan-"tageous than trusses; and it is also practically true, when such "materials are used as will not admit of the strain being received "on the abutments of the trusses. This is the case in the applica-"tion of iron, which, by the smallness of the dimensions, renders "the abutments useless, and thus necessarily causes the strain to "be sustained wholly on the fastenings. But when timber is used, "as the support is given with trusses by the strength of their "fibres, but with braces by the strength of the fastenings; the

" great superiority of the manner of sustaining the strain would in " practice more than counterbalance the mechanical advantage of " the brace, and would require the timbers, well secured at the " upper ends, to be laid in the direction of trusses. But though " timber, when applied only in one direction, should be laid as " trusses, it by no means follows, that when the timbers are to be " used both as trusses and braces, that the longest timbers should " be laid as trusses. That it would be sufficient to lay the timbers " only in one direction to support the strain, (though it would " prevent much of the arching) is fully disproved by the knowledge, " that the combination of the trusses and braces is insufficient totally " to prevent the arching; although it renders it so inconsiderable, " that it removes all the disadvantages of it. By supposing lines " perfectly inflexible, it has been shewn that arching can be alto- " gether prevented; but from the imperfection of materials and " workmanship, it is necessary to apply sufficient materials practi- " cally to prevent its disadvantages.

" If the longer pieces were laid in the contrary direction to what " they are at present, they would become the trusses and the " shorter pieces the braces. In this disposition the timbers would " be disadvantageously placed both as trusses and braces. The " whole strain on the truss would be supported on the upper end, " which would be likely to press into the timber against which it " abuts (which is continually found to be the case in great strains,) " and thus lessen the effect that the principle of the diagonal " framing is calculated to produce; but when the trusses are dis- " posed as at present, the whole of the strain on the upper truss is " not transmitted to the lower truss, part being sustained by the

" upper framing. The braces, which assist in preventing the ship's " arching by sustaining the strain on the fastening, would by being " in short pieces, by disuniting the connexion of the fastening in " the whole length, be rendered of much less strength: as the " strength of a brace depends on the mutual support of the bolts in " their connexion in the same piece.

" Again, if the longest pieces were laid as trusses, they would be " more likely to increase their curvature, and thus allow their upper " ends to fall and the ship to arch.

" Again, as the strain on the trusses necessarily tends to force out " the ship's bottom, this is admirably counteracted by the braces, " which in the present disposition draw in the ship's bottom in " sustaining the strain. Were the braces short pieces, which in a " contrary disposition would be the case, they would but in a small " degree prevent the defect which a system without braces would " experience in this particular.

" These advantages are quite distinct from the superiority that " the present disposition possesses in sustaining the strain, caused " by the ship's pitching and ascending; which though they tend to " break the ship in a contrary direction, yet by weakening the " fastenings, assists the constant force which causes the arching.

" The present disposition has peculiar advantages in sustaining " this strain from the manner and circumstances of its action.

" I conclude with the consideration, that if a system of braces " and trusses can scarcely be laid without advantages, of how much " greater advantage must a disposition be, in which the most proper " application is made of the materials!"

But in order to reduce to certainty the correct application of riders and trusses, and to prove their advantages, it was determined in the year 1817, that an experiment should be tried on the Justitia, an old Danish ship of 74 guns, which had been built in the year 1777, and from being in a very defective state and considerably arched, was under orders to be broken up. The ship in question was taken into dock upon straight blocks; by this means she was brought to her original sheer, and it appeared by the sights placed on the gundeck that she had broken in each half of her length two feet two inches and a half, and by those on the upper deck two feet three inches and a quarter. Shores lying at an angle of 45°, abuting at their lower ends against the keelson and at their upper ends against the orlop beams, with short pieces at right angles with, and lying between them, were placed in the hold and extending for about sixty-five feet in the fore, and seventy feet in the after body, the former (the shores) being placed in the direction that the trusses are in the ships built on Sir Robert Seppings's principle, and the latter in the direction of the braces; and a truss was placed in each port on both decks. When the Justitia, so fitted, was undocked, she broke in her sheer on the gundeck one foot two inches, and on the upper deck one foot two inches and five-eighths, and at the expiration of twenty-four hours a further alteration had taken place on both decks of two inches and five-eighths. The short pieces between the shores were observed to slacken as the ship was lifted by the water, and were when she floated, from one half of an inch to three and a half inches (according to their positions) short, and therefore partook of no part of the pressure; thus proving that the direction of the riders and trusses in the diagonal frame, as first applied, was perfectly correct. When the shores in the hold were disengaged the ship broke six inches, and upon the removal of the trusses in the ports, a further alteration of four inches took place, bringing the sheer to that which she had had before being docked.

If further evidence be necessary of the efficacy of the new mode of ship-building in preventing arching *, it is afforded by the comparative breaking in launching of three first-rate ships of war of 120 guns, constructed by the same drawings, (the St. Vincent, Nelson, and Howe), their frames, beams, and exterior planking being of precisely the same scantlings; the two former having been built according to the old plan, and the latter upon the diagonal system. After the Nelson was launched, she was found to have altered on the lower gun-deck $9\frac{1}{2}$ inches, and the St. Vincent $9\frac{1}{4}$ inches, from their original sheers. The Howe broke only $3\frac{5}{8}$ inches, or came to that position where the braces, trusses, *&c.*, were brought in close contact, and therefore into action; for while in the St. Vincent and Nelson the materials were observed to have been generally disturbed by the alteration which had taken place in their sheers, no such effect was discernible in the Howe.

The application of the diagonal system to the decks, to prevent lateral separation, has been found by comparative trials in the Northumberland of 74 guns (the decks on the one side being laid fore and aft, and on the other diagonally) to be far preferable to the old method of laying the planks in a right line fore and aft; this has been proved by the seams requiring to be caulked less frequently than in the decks laid according to the old plan.

After a sufficient time had elapsed to put the diagonal system of

* In page 410 of the first part of this work will be found some observations on the arching or hogging of ships and the means of prevention.

shipbuilding to the proof, and success had crowned the undertaking, a number of persons wished to lay claim to parts of the invention, and others attributed the merit of the whole to foreign nations. With respect to the first, their claims rested upon such slender foundations, that it would be a waste of time to enter upon them; and with regard to the latter, that the French and other naval powers laid materials diagonally in the holds of ships; this position is so ably, candidly, and methodically treated by a modern* writer, that no better illustration can be given than a translation of part of his Memoir.

"Without regard to national prejudices, I am obliged to render "entire justice to all the changes and to all the reproductions which "appear to me to be advantageous. I honour the services done to "art by a foreign power, as if they were rendered for my own "country and by one of my own countrymen; but, faithful to this "impartiality, I reclaim for other maritime powers than England, "the right which they have to a priority of invention and of practice "in many primitive ideas revived by Mr. Seppings.

"The old French constructors knew so well the truth of the "principle reproduced by Mr. Seppings, that they put it in practice "to bring about precisely the same results, the strengthening of "ships and preventing their arching. Instead of laying the interior "planking, or footwaling parallel to the exterior planking, care was "taken in all the parts of the hold from the orlop deck to the thick-"stuff at the floorheads, to give an oblique direction to the foot-"waling following the diagonals of the parallelograms formed by

* M. Ch. Dupin, in his Memoir *De la structure des vaisseaux Anglais, considérée dans ses derniers perfectionnements.*—Philosophical Transactions. for the Year 1817. Part I.

" the timbers and the outer planking; afterwards the riders covered " the oblique ceiling, and the transverse pieces run from one rider " to another following the direction of the second diagonal of the " same parallelograms.

" This system, maintained by a strong fastening, affords certainly " very great stiffness, but it has the inconvenience of being more " expensive than the ordinary method; and the oblique pieces " placed between the riders diminish the capacity of the hold " already much incumbered with the riders; it is also believed (but " incorrectly), that the longitudinal force of a ship is diminished " by the obliquity of the ceiling; these are probably the reasons " why the French gave up their ancient system.

" I have in my possession the vertical projection of the interior of " the hold of a ship, on which is shewn the mode of construction, " of which we have been speaking, the original design is more " than a hundred years old. I owe the knowledge of this fact to " M. Rollant, Joint Inspector of Maritime Affairs.

" A proposal was made, about the middle of the last century, to " cross the ceiling of our ships with oblique iron riders; this may be " seen in 'Duhamel's *l'Architecture Navale.*'

" At that period when the Academy of Sciences at Paris endea- " voured to direct the attention of learned men and artists to the " improvement of the marine, they offered three times, as their " prize-subject, the examination of the oscillations of rolling and " pitching, and the research of the means of rendering the car- " pentry of ships more proper to support the efforts resulting " from those motions.

" Chauchot, an engineer of the French marine, obtained the "prize in the year 1755, and in a memoir, very little known, "renewed the idea of substituting oblique riders for the common "ones.

"Groignard, an engineer of much celebrity, contended with "honour for the prize in 1759, but without obtaining it, because it "was gained by the great Euler. Groignard proposed for the bow "only, a system of working the stuff by panelling and planking, "which presents parallelograms strengthened by diagonals, This "idea did not rest upon speculation only, for in 1772 Clairon des "Lauriers, another French engineer, much in estimation, put it in "practice in the construction of L'Oiseau frigate.

"Bouguer, in his '*Traite du Navire*,' and since his time Chap-"man, a Swedish engineer, in his '*Architectura Navalis Mercato-"ria*,' have founded upon the principle reproduced by Mr. Sep-"pings, the means which they propose to give ships more of "stiffness. The decks of a ship, viewed with respect to the small "degree of their longitudinal curvature, may be regarded as paral-"lel to the interior pieces placed above the keel (*viz.*, the keelson), "the vertical pillars which support the decks perpendicularly on "the keelson, form with these, and the middle line of the decks, "quadrilaterals almost parallelograms.

"To prevent these parallelograms from altering their shape, and "consequently to hinder the vessel from arching, Bouguer has "placed, following the direction of the diagonal which tends to "elongate, bars of iron strongly united at their ends to the keelson "and the orlop deck. These bars resemble straps (*tirants*) in "common buildings.

"Chapman, on the contrary, has placed, following the direction "of the second diagonals (which tend to shorten) pieces of wood "well secured on the keelson and under the orlop deck; these "pieces of wood, which resist on being opposed to any compression, "do the office of supports against arching *(d'arc-boutants).*"

Such is the historical and descriptive account given by M. Dupin; in addition to which it may be mentioned, that Bouguer, in his "*Traité du Navire,*" published in 1746, gives the merit of the plan of laying the ceiling diagonally, to prevent arching, to a M. Gobert.

The success of our arms at sea has put us in possession of some practical instances to shew how far these methods assimilate to Sir Robert Seppings's. The Oiseau of 32 guns, constructed by Claron des Lauriers, was captured by the British in 1779, and sold out of the service in 1783; but no drawing or other record appears to have been preserved of the method in which her ceiling was laid.

Le Jupiter, a French ship of war, of 74 guns, captured in 1806, and since named the Maida, had eight vertical riders in the hold, the foremost one extending to within about 25 feet from forward, and the aftermost one to within about 45 feet from abaft; in this ship, the ceiling was laid horizontally as high as the floorheads, and the whole of the planking in the hold afore the foremost and abaft the aftermost rider, was also laid in that direction. Between the riders, from the floorheads to the orlop shelf-pieces, the planking was laid diagonally; in the two first spaces from the bow, it was placed in a direction from forward to aft, in the two next from aft to forward; in the two succeeding ones from forward to aft, and in the last from aft to forward. This plan, however, did not answer the intended purpose, for few ships have been found to be more arched than the Maida.

In the San Juan Nepomeceno of 74 guns, built at Ferrol about the year 1781, and captured from the Spaniards in the year 1805, there are riders which extend along the hold, laid in a diagonal direction over the ceiling.

In Russia, too, the importance of laying materials diagonally in ships has not been lost sight of; in the Pobedonossetz of 64 guns, constructed by their chief engineer, M. Brun, and launched in the year 1809, there are riders in the hold, which act as trusses, being laid in the fore-body, at about an angle of 45° from forward to aft, and in the afterbody at the same angle from aft to forward: there are in the same ship, breadth and top riders laid diagonally in a contrary direction to those in the hold, and dagger knees which attach the beams to the sides, the ends of the arms of which abut in many cases against the riders.

It is thus obvious, that it has been considered necessary for more than a century past, by most maritime countries, to cause variations to be made in the direction of some of the materials applied in ship-building, in order to prevent alterations in the original forms of the ships, and particularly arching in the direction of their length; and it is equally plain, that the attempts to effect this purpose by all the able engineers who have been named, were made by laying some of the materials, particularly in the hold, in a diagonal direction. But no sooner were their plans put in practice, than they were found not to answer the intended purpose, and were therefore abandoned; while, the advantages derived from Sir Robert Seppings's method, are proved by every day's experience and by numberless examples, which plan is now universally followed in building and repairing the British Navy, and has been adopted wholly, or in part, by many of our merchants, as well as by most of the maritime powers on the Continent of Europe.

If the failure of the methods heretofore practised, and the success which has attended Sir Robert Seppings's plan did not sufficiently stamp their difference, it would be seen by comparing the descriptions given of his method, and of those put in practice by other countries; and any unprejudiced mind would give to Sir Robert the merit of invention: being well assured of this, and feeling that he owes no obligations to those naval architects, who have heretofore laid materials diagonally, he has at all times courted discussion and inquiry on this point, and in carrying his plans into execution, has pursued them with ardour and never shrunk from responsibility.

Three-decked Ship of 120 Guns.

Names or Description of the Timbers.	Old Plan.						New Plan.					
	Number of Pieces.	Siding. Ft. Ins.	Length. From Ft. Ins.	Length. To Ft. Ins.	Rounding. From Ft. Ins.	Rounding. To Ft. Ins.	Number of Pieces.	Siding. Ft. Ins.	Length. From Ft. Ins.	Length. To Ft. Ins.	Rounding. From Ft. Ins.	Rounding. To Ft. Ins.
Floors	55	1 3½	29 6	19 0	1 1	5 3	..	..	..	..	..	..
Crosspieces	..	..	..	..	..	..	51	1 3½	13 0	22 0	0 3	2 0
Half Floors	20	1 1	10 0	4 0	0 1	0 6	142	1 3½	7 0	16 3	..	1 0
Futtocks double	16	1 2½	25 0	16 0	0 2	1 3	54	1 1	10 0	17 3	..	1 0
,, first	144	1 3½	21 6	14 6	0 1	3 1	102	1 2½	9 9	10 9	0 1	1 1
,, second	130	1 2½	16 6	15 0	0 4	1 7	164	1 2½	10 3	11 0	..	0 10
,, third	144	1 2	16 6	12 0	0 6	1 11	162	1 2	11 0	13 3	0 4	0 10
,, ,, lengthening Pieces	34	1 2	5 6	4 6	..	0 1	..	..	..	..	..	..
,, fourth	144	1 1	21 6	10 6	0 6	3 2	160	1 1½	10 6	12 9	0 9	0 10
,, ,, lengthening Pieces	36	1 1	4 6	4 6	0 0½	0 0½	32	1 1½	3 0	4 0	..	0 2
,, fifth	..	..	..	..	..	..	160	1 1	10 0	11 0	0 5	1 8
,, ,, lengthening Pieces	..	..	..	..	..	..	84	1 1	5 0	5 0	0 1	0 1½
,, sixth	..	..	..	..	..	..	152	1 1	10 9	18 0	0 8	1 2
,, ,, lengthening Pieces	..	..	..	..	..	..	84	1 1	6 0	15 0	0 1	0 4
Toptimbers long	106	1 1	25 0	15 6	0 10	1 4	80	1 1	11 9	17 6	0 1	0 4
,, lengthening Pieces	46	1 0	11 6	6 0	..	0 2	82	1 0	6 0	17 0	0 1	0 4
,, short	78	1 1	23 6	13 6	0 6	1 3	..	..	..	..	..	..
,, over Gundeck Ports	76	0 10	10 0	16 0	0 1	0 4	76	11	10 0	16 0	0 1	0 4
,, ,, Middledeck do.	74	0 10	9 0	16 0	0 1	0 3½	74	10½	9 0	16 0	0 1	0 3½
,, ,, Upperdeck do.	58	0 10	3 0	9 6	..	0 2	58	9½	3 0	9 6	..	0 2
,, ,, Quarterdeck do.	16	0 9	2 6	6 0	..	..	16	9	2 6	6 0	..	..

Two-decked Ship of 84 Guns.

Names or Description of the Timbers.	Old Plan.						New Plan.					
	Number of Pieces.	Siding. Ft. Ins.	Length. From Ft. Ins.	Length. To Ft. Ins.	Rounding. From Ft. Ins.	Rounding. To Ft. Ins.	Number of Pieces.	Siding. Ft. Ins.	Length. From Ft. Ins.	Length. To Ft. Ins.	Rounding. From Ft. Ins.	Rounding. To Ft. Ins.
Floors	54	1 3	16 0	29 0	1 5	5 0	..	..	..	..	..	..
Crosspieces	..	..	..	..	..	..	51	1 3	7 9	18 0	0 5	2 0
Half Floors	..	..	..	..	..	..	134	1 3	9 0	15 0	..	0 9
Futtocks double	36	1 2	14 0	21 6	0 8	2 10	44	1 3	9 0	13 0	0 6	1 6
,, first	146	1 3	11 0	20 10	0 3	2 7	102	1 3	9 0	11 0	..	1 1
,, second	108	1 2	13 6	15 0	0 1	1 7	142	1 2	9 0	11 0	..	1 0
,, third	140	1 1½	12 0	15 0	0 10	1 5	150	1 1½	9 6	12 0	..	0 11
,, ,, lengthening Pieces	32	1 1½	4 6	5 6	0 0½	0 1	..	..	..	..	..	..
,, fourth	136	1 0¾	11 0	20 6	0 11	3 9	148	1 0¾	10 0	12 6	0 9	1 3
,, ,, lengthening Pieces	32	1 0¾	4 6	4 6	0 0½	0 0½	32	1 0¾	4 3	4 9	0 1	0 1
,, fifth	..	..	..	..	..	..	150	1 0¾	8 6	17 0	1 0	1 6
,, ,, lengthening Pieces	..	..	..	..	..	..	118	1 0¾	7 6	18 0	0 1½	0 10
,, sixth												
,, ,, lengthening Pieces												
Toptimbers long	104	1 0½	13 0	24 0	0 9	1 2	116	Heel. 1 0¾ 0 11½ Head.	10 0	18 0	..	0 9
,, lengthening Pieces	..	..	..	..	..	..	36	0 11	4 0	11 0	..	0 2
,, short	82	1 0½	10 0	17 0	0 2	0 6	..	..	..	..	..	..
,, over Gundeck Ports	68	1 0	9 6	15 6	0 3	0 4	70	0 11	9 6	16 0	0 4	0 9
,, ,, Middledeck do.												
,, ,, Upperdeck do.	52	1 0	6 0	9 0	0 1	0 2	50	0 10	6 0	9 0	0 0½	0 2
,, ,, Quarterdeck do.	16	0 10	2 6	6 0	..	..	18	0 9	3 0	6 0	..	0 0½

Frigate of 60 Guns.

Names or Description of the Timbers.	Old Plan.						New Plan.					
	Number of Pieces.	Siding. Ft. Ins.	Length. From Ft. Ins.	Length. To Ft. Ins.	Rounding. From Ft. Ins.	Rounding. To Ft. Ins.	Number of Pieces.	Siding. Ft. Ins.	Length. From Ft. Ins.	Length. To Ft. Ins.	Rounding. From Ft. Ins.	Rounding. To Ft. Ins.
Floors	50	1 1	9 6	20 6	2 10	3 0	..	..	..	..	..	..
Crosspieces	..	..	..	..	..	..	45	1 1	4 6	10 0	1 1	2 0
Half Floors	..	..	..	..	..	..	126	1 1	8 0	12 0	0 3	0 10
Futtocks double	36	0 11½	9 0	15 6	0 6	1 5	60	1 0	7 0	14 0	0 7	1 7
,, first	134	1 1	9 6	15 6	..	1 4	90	1 1	10 6	12 6	0 1	0 9
,, second	100	1 0	10 0	11 0	..	0 8	126	1 0	9 0	10 3	..	0 10
,, third	130	0 11½	9 0	10 6	0 2	1 2	140	0 11½	9 0	9 6	0 3	1 1
,, ,, lengthening Pieces	..	..	..	..	..	..	..	..	..	..	..	..
,, fourth	128	0 11¼	9 0	10 6	0 10	1 8	140	0 11¼	10 [illegible]	11 0	1 1	1 5
,, ,, lengthening Pieces	32	0 11	4 6	6 6	0 0½	0 0½	30	0 11¼	3 [illegible]	5 0	..	0 2
,, fifth	..	..	..	..	..	..	140	0 11	7 [illegible]	16 0	0 3	2 1
,, ,, lengthening Pieces	..	..	..	..	..	..	66	0 11	4 [illegible]	8 0	0 0½	0 2
,, sixth												
,, ,, lengthening Pieces												
Toptimbers long	130	0 11	8 6	16 6	0 6	2 5	98	0 11	11 6	15 0	0 2	0 8
,, lengthening Pieces	70	0 11	7 0	11 0	0 0½	0 1	..	..	..	..	..	..
,, short	98	0 11	10 0	15 0	0 2	0 7	..	..	..	..	..	..
,, over Gundeck Ports												
,, ,, Middledeck do.												
,, ,, Upperdeck do.	60	0 10	6 0	6 0	0 0½	0 0½	62	0 10	6 0	6 0	..	0 1
,, ,, Quarterdeck do.												

Frigate of 46 Guns.

Names or Description of the Timbers.	Old Plan.						New Plan.					
	Number of Pieces.	Siding. Ft. Ins.	Length. From Ft. Ins.	Length. To Ft. Ins.	Rounding. From Ft. Ins.	Rounding. To Ft. Ins.	Number of Pieces.	Siding. Ft. Ins.	Length. From Ft. Ins.	Length. To Ft. Ins.	Rounding. From Ft. Ins.	Rounding. To Ft. Ins.
Floors	45	1 1	11 0	20 6	1 10	3 0	..	..	..	..	..	..
Crosspieces	..	..	..	..	..	..	47	1 3	5 6	11 0	0 11	1 10
Half Floors	..	..	..	..	..	..	122	1 3	7 6	11 6	..	0 8
Futtocks double	32	0 10¾	7 0	12 6	0 6	1 0	44	1 0	8 6	12 6	0 3	1 6
,, first	120	1 0½	8 0	16 0	0 3	2 0	94	1 0	9 0	11 3	0 1	0 4
,, second	90	0 11½	11 0	12 6	0 4	0 11	126	0 11	8 0	10 6	0 3	0 8
,, third	120	0 11	9 6	12 6	1 3	1 10	134	0 10½	7 0	9 0	0 5	0 11
,, ,, lengthening Pieces	30	0 11	4 6	5 6	0 0½	0 3	..	..	..	..	..	..
,, fourth	..	..	..	..	..	..	134	0 10¼	6 9	8 3	0 8	1 2
,, ,, lengthening Pieces	..	..	..	..	..	..	32	0 10¼	2 3	3 0	..	0 0½
,, fifth	..	..	..	..	..	..	138	0 10	6 6	16 6	0 4	0 9
,, ,, lengthening Pieces	..	..	..	..	..	..	40	0 10	7 6	7 6	0 2	0 3
,, sixth												
,, ,, lengthening Pieces												
Toptimbers long	120	0 10½	9 0	20 0	0 11	2 10	98	Heel. 1 10 0 9½ Head.	9 0	13 0	0 3	0 6
,, lengthening Pieces	..	..	..	..	..	..	..	..	..	..	..	..
,, short	90	0 10	9 0	13 0	0 3	0 7	..	..	..	..	..	..
,, over Gundeck Ports												
,, ,, Middledeck do.												
,, ,, Upperdeck do.	48	0 10	3 0	6 0	0 1	0 3	40	0 9½	6 0	6 0	..	0 1
,, ,, Quarterdeck do.												

28 Gun Ship.

Names or Description of the Timbers.	Old Plan.						New Plan.					
	Number of Pieces.	Siding. Ft. Ins.	Length. From Ft. Ins.	Length. To Ft. Ins.	Rounding. From Ft. Ins.	Rounding. To Ft. Ins.	Number of Pieces.	Siding. Ft. Ins.	Length. From Ft. Ins.	Length. To Ft. Ins.	Rounding. From Ft. Ins.	Rounding. To Ft. Ins.
Floors	31	0 10½	7 0	16 0	1 5	2 7	..	..	..	..	..	..
Crosspieces	..	..	..	..	..	..	36	1 3	5 0	10 6	1 2	1 8
Half Floors	..	..	..	..	..	..	96	1 3	[illegible] 0	10 0	0 2	0 11
Futtocks double	22	0 9	8 6	12 0	0 6	1 2	34	1 0	7 0	11 0	0 [illegible]	1 5
,, first	84	0 10	7 6	12 6	0 4	1 6	72	0 10	7 3	8 9	..	0 4
,, second	62	0 9½	9 0	9 6	0 4	0 9	94	0 9½	[illegible] 0	8 6	0 2	1 3
,, third	82	0 9½	8 0	9 6	1 1	1 5	98	0 9	6 0	8 6	0 8	1 4
,, ,, lengthening Pieces	18	0 9½	4 0	5 0	..	..	22	0 9	3 9	4 3	0 1	0 3
,, fourth	..	..	..	..	..	..	94	0 8½	6 0	14 9	0 6	1 11
,, ,, lengthening Pieces	..	..	..	..	..	..	10	0 8½	4 6	4 6	0 0½	0 0½
,, fifth	..	..	..	..	..	..	72	0 8½	10 0	18 9	0 5	0 6
,, ,, lengthening Pieces												
,, sixth												
,, ,, lengthening Pieces												
Toptimbers long	80	0 9½	7 0	14 0	0 5	1 9	58	0 8½	6 0	9 6	0 2	0 4
,, lengthening Pieces	46	0 9½	5 0	8 0	..	0 1						
,, short	68	0 9½	8 0	12 0	0 3	0 5	..	..	..	..	..	..
,, over Gundeck Ports												
,, ,, Middledeck do.												
,, ,, Upperdeck do.	26	0 9	2 6	5 6	..	0 0½	32	0 8	6 0	6 0	..	0 0½
,, ,, Quarterdeck do.												

Brig-Sloop of 10 Guns.

Names or Description of the Timbers.	Old Plan.						New Plan.					
	Number of Pieces.	Siding. Ft. Ins.	Length. From Ft. Ins.	Length. To Ft. Ins.	Rounding. From Ft. Ins.	Rounding. To Ft. Ins.	Number of Pieces.	Siding. Ft. Ins.	Length. From Ft. Ins.	Length. To Ft. Ins.	Rounding. From Ft. Ins.	Rounding. To Ft. Ins.
Floors	28	0 8	6 6	10 0	1 2	1 6						
Crosspieces	..	..	..	..	..	..	28	1 1	5 0	8 0	1 1	1 4
Half Floors	..	..	..	..	..	..	80	1 1	6 0	9 6	0 1	0 9
Futtocks double	22	0 6½	7 6	11 0	0 1	0 10	22	0 9	8 6	10 6	0 3	1 1
,, first	56	0 8	5 6	9 0	0 1	0 9	56	0 8	8 3	9 0	0 2	0 7
,, second	78	0 7	7 0	8 0	0 3	0 7	78	0 7	6 0	8 0	0 6	1 1
,, third	74	0 6½	6 0	8 0	0 6	1 1	74	0 6½	5 0	9 6	0 9	1 0
,, ,, lengthening Pieces	12	0 6½	3 0	3 0	..	0 0½						
,, fourth												
,, ,, lengthening Pieces												
,, fifth												
,, ,, lengthening Pieces												
,, sixth												
,, ,, lengthening Pieces												
Toptimbers long	74	0 6½	5 0	9 6	0 8	1 0	72	0 6½	4 9	6 0	..	0 0½
,, lengthening Pieces												
,, short	60	0 6½	4 9	6 0	..	0 1						
,, over Gundeck Ports												
,, ,, Middledeck do.												
,, ,, Upperdeck do.												
,, ,, Quarterdeck do.												

SECTION II.

METHODS OF PUTTING INTO PRACTICE SIR R. SEPPINGS'S PLAN OF CONSTRUCTING SHIPS OF WAR.

HAVING given, in the preceding chapter, an historic account of the rise and progress of the diagonal mode of ship-building in this country, and also shown how far the practices of other nations have in any way assimilated thereto; it remains now to point out the best methods of carrying it into effect in ships of war: and here it will be right to inform the ship-builder, that these practical methods, are the results which have arisen from very extensive experience, and from the works having been carried on, under the immediate superintendence of the inventor.

But before we enter at large upon the subject, it should be premised, that Sir Robert Seppings has introduced many improvements (independently of the diagonal system) in naval architecture, particularly that of the combination and better arrangement of the materials, so as to give strength to the fabric with economy in expenditure, and by making pieces of timber, of all sizes and forms, more generally applicable to the construction of ships: this has been called the small timbered system, or the adaptation of timber, heretofore considered as fit only from its size for the frames of frigates, to those of ships of the line. But the alterations made therein, in point of length, size and curvature, will be best shown by the annexed Table.

The distinguishing difference between the modes of converting the frames with small timbers, and with those of the ordinary scantlings, is, that the timbers are considerably reduced in their lengths and sidings; but in order to have the same quantity of materials in ships built according to this method, as there is in the old plan of framing, an additional timber has been introduced in the distance between port and port, and also one under each port, and the frames have been formed with three instead of two bends of timbers. The head and heel of each timber, being in this, as well as in the ordinary method of framing converted square, are united by a circular coak, the diameter of which is about one third of the siding of the respective timbers, and before being put together, the coaks and the heads and heels of the timbers are painted; the pigment used for this purpose is white lead. In uniting the frames, two bolts are placed in each scarph, in the upper ones of one and one eighth of an inch diameter in ships of the line, and of one inch diameter in frigates, and in the lower scarphs, of one and one-fourth of an inch diameter for ships of the line, and one and one-eighth of an inch for frigates.

This method of framing ships, was first put in practice on His Majesty's ship Talavera of 74 guns, launched in the year 1818, at Woolwich, and a very particular account was kept of the expense incurred; and on being compared with that in converting the frame of the Black Prince, a ship of the same class, built at the same dock-yard, the result was, that a saving of 996*l.* arose from the new method of conversion. As the plan has advanced towards perfection, a much larger saving now arises from the conversion of the frame of each ship of the line.

The new plan is decidedly preferable in point of strength; this obviously arises from the connexion of the heads and heels of the timbers, and from their joints being better supported by a union of three timbers instead of two: in getting up the frames of the Talavera, it was proved that the alteration which took place from their original form was only from one eighth to three eighths of an inch, and not the least racking was observed at their heads and heels; while those in the Black Prince altered from one half of an inch to two inches, and racked from three quarters to one inch.

Converting the timbers with square heads and heels and decreasing their lengths, have given great facilities to the economical and proper conversion of the wood; no delay now takes place in providing any article, the pieces of timber in the piles, taken promiscuously, are generally applicable to all purposes; and hence no logs become rotten by being laid aside for many years, (which used to be the case to a great extent,) on account of their inapplicability.

When the timber in store is generally of such dimensions as to admit of its being converted, with greater economy, of large sidings, it is uniformly done, by placing six timbers between port and port instead of seven, and two only, (which are regularly spaced,) under each port; but in this case also, they are in general reduced considerably in length, in order to assist the conversion. The following are the scantlings of the ships of the several classes built according to Sir R. Seppings's diagonal principle, with timbers of the greater lengths and larger sidings.

Dimensions and Scantlings of the principal Timbers, Plank, &c., in the Classes of Ships undermentioned.

DESCRIPTION.	SHIPS OF THE LINE.			FRIGATES.				SLOOPS.	
	1 Rate of 120 Guns.	2 Rate 84 Guns.	3 Rate 74 Guns.	4 Rate 60 Guns.	5 Rate 46 Guns.	5 Rate 42 Guns.	6 Rate 28 Guns.	Ship of 18 Guns.	Brig of 10 Guns.
PRINCIPAL DIMENSIONS.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.
Length, on the lower-deck	205 5½	196 1½	176 0	172 0	150 1½	145 0	113 8	108 4 On Upper	90 0 Deck.
,, computed, of the keel for tonnage	170 11	161 11½	145 1	144 9	125 4⅞	121 9⅜	94 8¾	90 6	73 7⅞
Breadth extreme, to the thickness of the plank of the bottom	53 6	51 5¼	47 6	43 8	39 11	38 2	31 6	28 10	24 6
Depth in hold	23 2	22 6	21 0	14 6	12 9	13 3	8 9	7 9	11 0
Burthen in tons . . . No.	2602	2279	1741	1468	1063	944	500	400	235
ORDNANCE WHICH THEY CARRY.	No. Pr.	No. Pr.	No. Pr.	No. Pr.	No. Pr.	No. Pr.	No. Pr.	No. Pr.	No. Pr.
On the Gundeck	32 32	28 32	28 32	30 24					
Carr[ds]	. . .	2 68							
,, Middledeck	34 24								
,, Upperdeck	34 24	32 24	28 18	2 24	28 18	26 18	. . .	2 6	2 6
Carr[ds]	. . .	. . .	. . .	28 42	. . .	. . .	20 32 Car.	16 32 Car.	8 18 Car.
,, Quarterdeck	6 12	6 12	4 12						
Carr[ds]	10 32	10 32	10 32	. . .	14 32	12 32	6 18		
,, Forecastle	2 12	2 12	2 12	. . — .	2 9	2 9	2 9		
Carr[ds]	2 32	4 32	2 32	. . .	2 32	2 32			
,, Roundhouse . . Carr[ds]	6 18	6 18	6 18						
FRAME.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.
Keel . . square in midships	1 8	1 7½	1 6	1 4	1 3½	1 3	1 1	1 0	0 11 Sided; 1 3 Deep
,, . . sided afore	1 6	1 5½	1 4	1 1¼	1 1	1 0½	0 11	0 10¼	0 9
,, abaft	1 3	1 2½	1 1½	1 1¼	1 0	0 11½	0 10½	0 9½	0 9
Keelson; ,, additional	The same dimensions as the keel in midships.								
,, ,, . . length	28 0	28 0	28 0	26 0	24 0	24 0	18 0	14 0	13 0
Stem main: Square at the head	1 8	1 7½	1 6	1 4	1 4	1 3½	1 2	1 4	1 2
Stem main: ,, fore foot	1 6	1 5½	1 4	1 4	1 3½	1 3	1 1	1 1	0 10

DESCRIPTION.	SHIPS OF THE LINE.			FRIGATES.				SLOOPS.	
	1 Rate of 120 Guns.	2 Rate 84 Guns.	3 Rate 74 Guns.	4 Rate 60 Guns.	5 Rate 46 Guns.	5 Rate 42 Guns.	6 Rate 28 Guns.	Ship of 18 Guns.	Brig of 10 Guns.
Frame—*continued.*	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.
Post stern: Square at the head .	2 1	2 0	1 11	1 6	1 6	1 6	1 3	1 2	0 11
Post stern: Fore and aft on the keel false post included .	3 0	2 10	2 9	2 1	2 0	2 0	1 10	1 11	1 8½
,, inner: Fore and aft at upper end	1 2	1 2	1 1	0 11	0 10	0 10	0 8	0 8	0 7
,, inner: On the keel . .	1 8	1 7	1 6	1 2	1 2	1 2	0 10	0 10	0 10
Room and space of the timbers . .	2 10	2 9¾	2 9¼	2 7¾	2 6½	2 6¼	2 6	2 5¼	2 4¾
Floor timbers or half floors, sided in midships	1 3½	1 3	1 2	1 1	1 0	0 11½	1 0	1 0	0 8
,, ,, afore and abaft	1 2½	1 2	1 1	1 0½	0 11¼	0 10¾	1 0	1 0	0 7
,, moulded at their heads . .	1 2½	1 2	1 1	1 0	0 11	0 10½	0 8¾	0 8	0 7
N. B. As the lower parts of ships are now made solid by fillings, *&c.*, the floors and first futtocks may be sided as large as the respective pieces of timber from which they may have been converted, and the size of the openings will admit.									
Futtocks first, sided in midships .	1 3½	1 3	1 2	1 1	1 0	0 11½	0 10	0 9½	0 8
,, ,, ,, afore and abaft .	1 2½	1 2	1 1	1 0½	0 11¼	0 10¾	0 10	0 9	0 7
,, ,, moulded at their heads	1 2	1 1½	1 0½	0 11½	0 10½	0 10	0 8¾	0 7½	0 6½
,, second, sided in midships .	1 2½	1 2	1 1	1 0	0 11	0 10½	0 9½	0 8½	0 7
,, ,, ,, afore and abaft	1 1½	1 1	1 0¼	0 11½	0 10½	0 10	0 9½	0 8½	0 6½
,, ,, moulded at their heads	1 1½	1 1	1 0	0 11	0 10⅛	0 9½	0 8	0 7	0 6¼
,, third, sided in midships .	1 2	1 1½	1 0½	0 11½	0 10½	0 10	0 9	0 8	0 6½
,, ,, ,, afore and abaft	1 1	1 0½	1 0	0 11¼	0 10¼	0 9½	0 9	0 8	0 6
,, ,, moulded at their heads	1 1	1 0½	0 11½	0 10½	0 9½	0 9	0 7½	0 6½	0 6
,, fourth, sided	1 1	1 0¾	1 0	0 11¼	0 10¼	0 9¾	0 8½	0 8	
,, ,, moulded at gundeck waterways . .	1 0¼	1 0¼	0 11¼						
,, ,, moulded at middledeck waterways . .	1 0								
,, ,, moulded at upperdeck waterways . .	0 10	0 10	0 10	0 9½	0 9	0 8½	0 7	0 6	

DESCRIPTION.		SHIPS OF THE LINE.			FRIGATES.				SLOOPS.	
		1 Rate of 120 Guns.	2 Rate 84 Guns.	3 Rate 74 Guns.	4 Rate 60 Guns.	5 Rate 46 Guns.	5 Rate 42 Guns.	6 Rate 28 Guns.	Ship of 18 Guns.	Brig of 10 Guns.
FRAME—*continued.*		Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.
Toptimbers, sided at their heels and upper futtock heads . . .		1 1	1 0¾	1 0	0 11	0 10	0 9½	0 8½	0 8	0 6½
Toptimbers, sided at the top of the side		0 11½	0 11½	0 11½	0 10½	0 9½	0 9	0 8½	0 7½	0 6
Toptimbers, moulded at the upper edge of the sheer strake in the waiste .		0 6¼	0 6¼	0 6	0 5½	0 5¼	0 5⅛	0 5	0 5	0 5
Toptimbers, moulded at the upper edge of the sheer strake afore . .		0 7¼	0 7	0 6½	0 6¼	0 5⅝	0 5⅝	0 5	0 5	0 5
Toptimbers, moulded at the upper edge of the sheer strake abaft .		0 7	0 6⅞	0 6⅝	0 5½	0 5⅝	0 5⅝	0 5	0 5	0 5
Toptimbers, moulded at upperside of quarterdeck and forecastle ports .		0 5	0 5	0 5	0 4	0 4	0 3¾	0 3½		
N. B. Those toptimbers which run up, so as to form the sides of ports, are continued upward the same sidings as at their heels. And although in some cases, in order to shorten the timbers, and thereby reduce their curvature, lengthening pieces are introduced, and in others an additional timber in each frame for the same purpose, yet the scantlings remain the same at the positions stated above.										
IN HOLD.										
Limber strake . .	thick .	0 8	0 7	0 7	0 6	0 6	0 6	0 4	0 4	0 3
Diagonal riders or braces upper and lower . . .	square	1 2	1 2	1 1						
	sided .	. . .	. . .	. . .	0 11	0 11	0 11			
	moulded	. . .	. . .	. . .	0 6	0 6	0 6			
Diagonal riders or braces, middle	square	1 3	1 2	1 2						
Diagonal trusses . .	square	1 0	1 0	0 11						
	sided .	. . .	. . .	. . .	0 10	0 10	0 10			
	moulded	. . .	. . .	. . .	0 6	0 6	0 6			
Fore and aft, or longitudinal pieces at floorheads . .	square	1 2	1 2	1 1						
	sided	. . .	. . .	. . .	0 11	0 11	0 11			
	moulded	. . .	. . .	. . .	0 6	0 6	0 6			
Fore and aft, or longitudinal pieces at first futtock heads	square	1 0	1 0	0 11						
	sided .	. . .	. . .	. . .	0 11	0 11	0 11			
	moulded	. . .	. . .	. . .	0 6	0 6	0 6			
N. B. In the fore and after bodies of ships, the sidings of the riders, trusses, and longitudinal pieces are one inch less than those dimensions.										

DESCRIPTION.		SHIPS OF THE LINE.			FRIGATES.				SLOOPS.	
		1 Rate of 120 Guns.	2 Rate 84 Guns.	3 Rate 74 Guns.	4 Rate 60 Guns.	5 Rate 46 Guns.	5 Rate 42 Guns.	6 Rate 28 Guns.	Ship of 18 Guns.	Brig of 10 Guns.
IN HOLD—*continued.*		Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.			
Trusses of iron	broad	. . .	. . .	. . .	0 6	0 6	0 6			
	thick	. . .	. . .	. . .	0 1	0 1	0 1			
								Ft. Ins.	Ft. Ins.	Ft. Ins.
Thickstuff at floorheads, when iron trusses are used in frigates, and when not used in small ships	broad	. . .	. . .	. . .	1 8	1 8	1 8	1 6	1 6	1 6
	thick	. . .	. . .	. . .	0 6	0 6	0 6	0 4½	0 3	0 3
Thickstuff at first futtock heads, ditto	broad	. . .	. . .	. . .	1 8	1 8	1 8	1 6	1 6	1 6
	thick	. . .	. . .	. . .	0 6	0 6	0 6	0 4	0 3	0 2
		C. Qr. Lb.	C. Qr. Lb.	C. Qr. Lb.	C. Qr. Lb.	C. Qr. Lb.	C. Qr. Lb.			
Hooks iron	weight	5 1 14	5 1 14	5 1 14	4 1 7	4 1 7	4 1 7			
Crutches iron	„	5 1 14	5 1 14	5 1 14	4 1 7	4 1 7	4 1 7			
ORLOP DECK.		Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.			
Beams	square	1 3½	1 3	1 2	1 0	0 10	0 9½			
„ to round		0 2½	0 2½	0 2½	0 2	0 2	0 2			
„ half	square	0 11	0 10½	0 10½	0 10	0 8	0 8			
Shelf-pieces	broad	1 0	1 0	1 0	0 11	0 11	0 11			
	thick	0 10	0 10	0 10	0 11	0 11	0 11			
Clamps	„	0 8	0 7	0 7	0 6	0 5	0 5			
Chocks under shelf-pieces	sided	1 0	1 0	0 11	0 11	0 10	0 10			
Side plates for attaching the beams to the sides	broad	0 5	0 5	0 5	0 4½					
	thick	0 1⅜	0 1⅜	0 1⅜	0 1¼					
Strake on the ends of beams	thick	0 8	0 7	0 7	0 5	0 4	0 4			
GUNDECK IN SHIPS OF THE LINE, OR LOWER DECK IN FRIGATES AND SMALLER CLASSES.										
Beams	square	1 5	1 4½	1 3½	0 11¼	0 10½	0 10	0 8½	0 8	0 6
„ to round		0 5	0 5	0 5	0 5	0 5	0 5	0 5	0 4	
„ half	square	0 11	0 10½	0 10½	0 10	0 8	0 8	0 5½		
Shelf-pieces	broad	1 2	1 2	1 2	1 2	1 0	1 0	1 0	0 11	0 11
	thick	0 10	0 10	0 10	0 8	0 7	0 7	0 9	0 8	0 8
Clamps	„	0 9	0 8	0 8	0 5½	0 5	0 5	0 4	0 4	0 3

DESCRIPTION.		SHIPS OF THE LINE.			FRIGATES.				SLOOPS.	
		1 Rate of 120 Guns.	2 Rate 84 Guns.	3 Rate 74 Guns.	4 Rate. 60 Guns.	5 Rate 46 Guns.	5 Rate 42 Guns.	6 Rate 28 Guns.	Ship of 18 Guns.	Brig of 10 Guns.
GUNDECK, &c.—*continued.*										
Chocks under shelf-pieces .	sided	Ft. Ins. 0 10	Ft. Ins. 0 10	Ft. Ins. 0 10	Ft. Ins. 0 9	Ft. Ins. 0 7	Ft. Ins. 0 7	Ft. Ins. 0 7		
Knees iron forked . .	weight	C. Qr. Lb. 3 2 0	C. Qr. Lb. 3 2 0	C. Qr. Lb. 3 2 0						
„ under the beams .	„	. . .	. . .	. . .	C. Qr. Lb. 1 2 0	C. Qr. Lb. 1 2 0	C. Qr. Lb. 1 2 0			
Spirketting . . .	thick	Ft. Ins. 0 7	Ft. Ins. 0 6	Ft. Ins. 0 6	Ft. Ins. 0 5	Ft. Ins. 0 4	Ft. Ins. 0 4	0 3	Ft. Ins. 0 3	
Waterways . . .	square	1 2	1 2	1 1	1 0	0 10½	0 10½	0 9½	0 9½	
Plank of the deck . .	thick	0 4	0 4	0 4	0 3	0 3	0 3	0 2	0 2	Ft. Ins. 0 1½
MIDDLE DECK.										
Beams	sided	1 3								
	moulded	1 1								
„ to round		0 7½								
„ half . .	square	0 10								
Shelf-pieces	broad	1 1								
	thick	0 8								
Clamps	„	0 7								
Chocks under shelf-pieces .	sided	0 9								
Knees iron forked . .	weight	C. Qr. Lb. 2 3 0								
Spirketting . . .	thick	Ft. Ins. 0 6								
Waterways . . .	square	1 1								
Plank of the deck . .	thick	0 3								
UPPER DECK.										
Beams	sided	1 1½	1 1	1 1	1 1	1 0	0 11½	0 10	0 9½	0 7½
	moulded	1 0	1 0	1 0	1 0	0 11	0 10½	0 9	0 8½	0 7½
„ to round		0 8	0 7½	0 7½	0 8	0 8	0 8	0 6½	0 5½	0 5½
„ half	square	0 9	0 9	0 9	0 9½	0 9½	0 9½	0 5½		
Shelf-pieces	broad	1 1	1 1	1 1	1 1	1 1	1 1	1 0	1 0	1 0
	thick	0 8	0 8	0 8	0 8	0 8	0 8	0 7	0 7	0 6
Clamps . . .	„	0 6	0 6	0 5½	0 6	0 5	0 5	0 4	0 4	0 4

DESCRIPTION.		SHIPS OF THE LINE.			FRIGATES.				SLOOPS.	
		1 Rate of 120 Guns.	2 Rate 84 Guns.	3 Rate 74 Guns.	4 Rate 60 Guns.	5 Rate 46 Guns.	5 Rate 42 Guns.	6 Rate 28 Guns.	Ship of 16 Guns.	Brig of 10 Guns.
UPPER DECK—*continued.*										
Chock under the shelf-pieces,	sided	Ft. Ins. 0 8½	Ft. Ins. 0 8½	Ft. Ins. 0 8½	Ft. Ins. 0 8	Ft. Ins. 0 8	Ft. Ins. 0 8	Ft. Ins. 0 7	Ft. Ins. 0 7	Ft. Ins. 0 7
Knees iron forked . .	weight	C. Qr. Lb. 2 1 0	C. Qr. Lb. 2 1 0	C. Qr. Lb. 2 1 0	C. Qr. Lb. 2 1 0	C. Qr. Lb. 2 1 0	C. Qr. Lb. 2 1 0			
,, under the beams	,, .	. . .	. . .	. . .	. . .	. . .	. . .	C. Qr. Lb. 1 1 0	C. Qr. Lb. 1 0 14	C. Qr. Lb. 1 0 7
Spirketting . . .	thick	Ft. Ins. 0 5	Ft. Ins. 0 5	Ft. Ins. 0 4½	Ft. Ins. 0 4½	Ft. Ins. 0 4½	Ft. Ins. 0 4½	Ft. Ins. 0 3	Ft. Ins. 0 3½	Ft. Ins. 0 3
Waterways . . .	square	1 1	1 0½	1 0½	1 0	0 11½	0 11½	0 11	0 11	0 9
Plank of deck . .	thick	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 3	0 2½
QUARTER DECK.										
Beams	sided	0 9¾	0 9½	0 9	0 11	0 7½	0 7¼	0 6½		
	moulded	0 8¾	0 8½	0 8	0 8	0 7½	0 7¼	0 5½		
,, to round		0 8	0 8½	0 8½	0 8	0 7½	0 7½	0 7		
Shelf-pieces . . .	broad	1 0	1 0	1 0	0 11	0 11	0 11	0 10		
	thick	0 7	0 7	0 7	0 6½	0 6½	0 6½	0 5		
Clamps	,,	0 4	0 4	0 4	0 4	0 4	0 4	0 3		
Chocks under shelf-pieces	sided	0 7½	0 7½	0 7½	0 7	0 7	0 7	0 6		
Spirketting . . .	thick	0 3	0 3	0 3	0 3	0 3	0 3	0 3		
Waterways . . .	square	0 10½	0 10½	0 10½	0 10½	0 10½	0 10½	0 10		
Plank of the deck . .	thick	0 3	0 3	0 3	0 3	0 3	0 3	0 2½		
FORECASTLE.										
Beams . . .	sided	0 9¾	0 9½	0 9	0 9	0 8½	0 7¼	0 6½		
	moulded	0 8¾	0 8½	0 8	0 8	0 7	0 7¼	0 5½		
Shelf-pieces . .	broad	1 0	1 0	1 0	0 11	0 11	0 11	0 10		
	thick	0 7	0 7	0 7	0 6½	0 6½	0 6½	0 5		
Clamps	thick	0 4	0 4	0 4	0 4	0 4	0 4	0 3		
Chocks under shelf-pieces .	sided	0 7½	0 7½	0 7½	0 7	0 7	0 7	0 6		
Knees iron forked . .	weight	C. Qr. Lb. 1 2 0	C. Qr. Lb. 1 2 0	C. Qr. Lb. 1 2 0						
Spirketting . . .	thick	Ft. Ins. 0 3	Ft. Ins. 0 3	Ft. Ins. 0 3	0 3	0 3	0 3	0 2½		
Waterways . . .	square	0 10½	0 10½	0 10½	0 10½	0 10½	0 10½	0 10		
Plank of the deck . .	thick	0 3	0 3	0 3	0 3	0 3	0 3	0 2½		

DESCRIPTION.		SHIPS OF THE LINE.			FRIGATES.				SLOOPS.	
		1 Rate of 120 Guns.	2 Rate 84 Guns.	3 Rate 74 Guns.	4 Rate 60 Guns.	5 Rate 46 Guns.	5 Rate 42 Guns.	6 Rate 28 Guns.	Ship of 18 Guns.	Brig of 10 Guns.
ROUND-HOUSE.		Ft. Ins.	Ft. Ins.	Ft. Ins.						
Beams	sided	0 7	0 7	0 6½						
	moulded	0 6	0 5¾	0 5½						
,, to round		0 11	0 11	0 11						
Shelf-pieces	broad	0 10	0 10	0 10						
	thick	0 6	0 6	0 6						
Clamps	thick	0 3½	0 3½	0 3½						
Chocks under shelf-pieces	sided	0 6	0 6	0 6						
*Waterways	square	0 9	0 9	0 9						
*Plank	thick	0 2½	0 2½	0 2½						
WITHOUT BOARD.					Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.	Ft. Ins.
Wales main	broad	5 0	4 8	4 5	3 9	3 10	3 8	3 4	3 2	2 3
	thick	0 10	0 9½	0 8½	0 7½	0 7	0 6½	0 5	0 5	0 4
,, thickstuff above	,,	0 8½	0 8	0 7	0 6	0 5	0 5	0 4	0 3½	0 3
,, thickstuff under		The upper edge of the upper strake the same thickness as the main wales, and this and the other strakes diminish gradually until they are brought to the thickness of the bottom.								
,, middle	broad	3 0								
	thick	0 5½								
,, channel	broad	2 8	3 0	3 0						
	thick	0 5	0 5	0 5						
Sheerstrakes	thick	0 3½	0 4	0 4	0 4	0 4	0 4	0 3	0 3	0 3
Plank of bottom	,,	0 4½	0 4½	0 4	0 4	0 4	0 3½	0 3	0 3	0 3

In the aforegoing scantlings it has not been considered necessary to enter into copious details, as this is so ably and altogether so accurately done in the extensive tables (from folio 1 to 58) given in a former part of this work, and to which the reader is referred. Those tables must have been the result of long and patient investigation; and it is but justice to say, that they are the most perfect of their kind, such as are not to be found in any other book, may at all times be consulted with profit, and cannot fail to be interesting to all those who are in any way concerned in the construction of ships.

It now remains to give the practical methods of carrying on the work in ships of the line and frigates, built by the diagonal system.

Frame.—Half floors are introduced generally; this is done for the purpose of economical conversion, and to give strength, they are formed into floors by a chock or cross piece, which is coaked and bolted to them and to the dead wood.—*See Plate K. fig.* 6.

All the timbers are framed together in bends, (except the short timbers over the ports), and each scarph secured, as before observed, with two bolts of one inch and one-eighth diameter in ships of the line, and with those of one inch diameter in frigates.

The first futtocks are bolted to the respective floors, with which they come in contact, with two bolts in each scarph of one inch and one quarter diameter in ships of the line, and one inch and one-eighth in frigates; and the filling frames under the ports are so opened as to divide the space in which they are placed, equally.

The heads and heels of all the timbers are converted square, painted at each end with white lead, and united one to the other with a circular coak, formed from hard, well-seasoned, durable wood, which coaks are, previously to their being used, soaked in train oil and then painted.

The chocks, which it is necessary to place between the frame timbers to keep them at a proper distance for seasoning, are removed, (to prevent the lodgment of dirt or chips), previously to the planking being commenced.

The frames are filled in to within a few inches of the orlop clamps, (having previously been paid over with coal tar in wake of the fillings), so as to form one solid mass, the fillings for this purpose are of about four feet each in length, and three inches in thickness, and converted from dry oak timber; these are first placed fair with the outer side of the timbers, and then slightly caulked on one side, and well raimed and caulked on the other: cement, formed of two parts of Parker's cement and one of drift sand, is then placed on the outer filling, to within two inches and an half of the inner surface; a filling of three inches in thickness, similar to the outer filling, is then tightly driven from the inside, which, by pressing on the cement before it becomes fixed, forces it into all the interstices. And in order to economize this mixture, whole bricks or pieces of bricks are placed in those openings which may be wide enough to receive them without their coming in contact with the timbers: the inner fillings are caulked in the same manner as the outer. The inside of the ship is then dubbed moderately fair.

As whale and some other oils have been found to preserve timber, basins are formed in the heads of the stem, stern-post and timbers under the ports; holes are then bored in the centres of these some distance down the timbers, which are kept filled with train oil during the time the frames of the ships stand to season, which periods are twelve months for a ship of the line, and six months for a frigate; after these have elapsed, the holes are plugged up, the heads of the timbers cut off fair, and then painted with white lead.

Planking without Board.—The plank of the bottom is secured by a copper bolt in each but, and by only one treenail passing through each timber; these, with the through bolts which attach the diagonal framing placed within board, are considered to be a sufficient degree of fastening, and the timbers and plank are less perforated, and thereby less weakened, than by the former practice of double and single fastening through the timbers alternately.

The main wales, blackstrake, upper strakes of diminishing stuff, middle wales, channel wales and sheerstrakes, are (for the purpose of steadying the timbers and preventing the buts drawing apart) coaked to the timbers of the frame; where three or more strakes, by two coaks being placed in the strakes above and below that in which the buts meet, and in the timbers immediately afore and abaft the buts; where there are less than three strakes, then both buts are coaked to those timbers which come the nearest to their ends.

The clamps and spirketting are also coaked to the timbers of the frame in a similar manner to the wales, and to prevent them from being split by the in-and-out fastenings which pass through them, up and down bolts are introduced in the centre of the thickstuff.

Within Board, Limber Strakes in Hold.—The limber strakes are coaked to the cross pieces; the coaks used for the purpose in ships of the line are of four inches and an half, and in frigates four inches diameter, and are in each case four inches long.

Keelsons additional.—An additional keelson is worked on each side of the ship in wake of the mainmast, and placed at such a distance from the keelson, that the ends of the step for the mast may rest upon them, *(Plate K, ref. A.)* the usual keelson as well as the two additional keelsons are secured to the cross pieces by coaks as well as by bolts.

Trussed Frame.—The disposition of the several parts of the trussed frame in a ship of the line with two decks is shewn in *Plate K. fig.* 1. The trussed frame is composed of diagonal timbers, (marked B.), longitudinal pieces (marked C.), and trusses (marked D.)

In executing the work, the middle diagonal timber, (where there are three to form a bend), is first got into its station, and laid as nearly to a right angle from the body of the ship as possible; the upper part abutting against the fore and aft stuff that runs under the orlop clamps, and the lower part is continued two feet six inches below the floor-heads, or as much more as the length of the piece will admit; making an angle of 45° with the timbers of the frame. The lower diagonal timber is next placed and runs from at least two feet six inches above the floorheads to within three inches of the limber strake, giving thereby a scarph of not less than five feet to the middle timber: and in order to make this timber lie nearer to a right angle with the body, the lower end of the middle timber is reduced at the upper part, where it comes in contact with the lower timber; in the fore body it is taken from the aftside, and in the after body from the foreside.

The upper diagonal timber runs from the side of the chock under the gun-deck beam, to the head of the middle timber: in disposing of this timber, it is generally necessary to take away a chamfer of about six inches from the angle of the lower edge of the orlop beam, in order to preserve the proper diagonal direction of the timber, and to allow the head of it to reach as high as possible up the chock under the shelf-piece. A chock is then placed on the inside of the diagonal timber reaching from the orlop shelf-piece to about four feet below the head of the middle timber, for the double purpose of giving support to the shelf-piece and forming a continuity of strength between the upper and middle diagonal timbers. The scarph formed by the middle and lower pieces of the diagonal timbers is secured with two copper bolts, which are driven square from the sides of the timbers, the diameters of these bolts are the same as those which secure the riders.

The diagonal timbers thus connected, form strong braces or ties, and are placed against every alternate beam, except afore the foremast and abaft the mizenmast, where they are placed against every beam. At these parts of the ship the braces are made of two timbers only; the lower ones run to the middle line, where meeting with the same description of timbers worked on the opposite side of the ship, they form breasthooks forward, and crutches abaft, by being united with iron straps about fourteen feet long, four inches broad, and one inch and an half thick in the middle, but only three quarters of an inch thick at their ends, bolted with ten bolts of one inch and a quarter diameter in ships of the line, and one inch and one-eighth in frigates.

If any difficulty occur in procuring compass timber for the diagonal timbers in ships of the line, a saw kerf is cut in the upper part of the upper and in the lower part of the lower timber, thus avoiding a kerf in wake of the scarph. Or if the scantlings will admit of it, as is the case in frigates, the wood is brought to the curvature required, by being boiled.

The diagonal timbers are coaked to the frame timbers, and to the gundeck and orlop clamps with which they come in contact, with coaks three inches and a half long and three inches and a half diameter; these are placed about three feet apart.

The longitudinal pieces are placed at the floor and first futtock heads in ships of the line, built with long timbers, but at the floor and second futtock heads in ships built with short timbers. They have their ends secured to the diagonal timbers with coaks four inches long and four inches diameter; the coaks used for the purpose must be double sunk, and whenever the necessity of double sinking coaks exists, the vacant space is invariably filled up with a mixture of chalk and tallow, or with cement. In frigates the ends of the longitudinal pieces are not coaked. The lower trusses are placed from one angle, formed by the diagonal timber and longitudinal pieces, to its opposite angle; the upper ones are laid above a square or 90° from the diagonal timbers. The longitudinal pieces and trusses are procured, if possible, from old ship-timber, which, before being put into place, is saturated with oil, and then painted with white lead to prevent an absorption of moisture.

Great attention is paid to drive in very tight the fore and aft pieces at the floor and first futtock heads, and more particularly so the trusses, as they receive the weight of the ship when she has a tendency to arch or hog. As no coaks are required at the ends of the trusses, should they by accident be cut short, or should the braces have shrunk after the trusses were put in place, thin iron-plate wedges are driven in, prior to the ship's being launched or undocked.

The diagonal timbers in ships of the line are secured with copper bolts of an inch and a quarter diameter; the bolts are placed from eighteen to twenty inches apart, except at their extreme ends, where two bolts are placed nearly abreast; and at the heads of those under the gun-deck shelf-piece, these bolts are driven through a plate of iron to secure them, and prevent their moving when the ship is in the action of rolling. In frigates, the bolts of the diagonal timbers for the upper range and for those parts which form hooks and crutches are one inch and one-eighth, the remainder one inch diameter.

The longitudinal pieces at the floor and futtock heads in ships of the line are fastened at their ends with bolts of an inch and a quarter diameter, and in the middle with bolts of an inch and one-eighth diameter, which are placed from one foot eight inches to two feet asunder; their ends excepted, where, as is the case in the ends of the diagonal timbers, they are put nearly abreast. In frigates, the bolts are placed the same as in ships of the line, but they are only of seven-eighths of an inch diameter.

The trusses in ships of the line are secured with bolts of an inch and one-eighth diameter; and in frigates with those of seven-eighths of an inch diameter, which are placed about two feet asunder.

In driving the bolts of the diagonal frame, all those in the ends, and at least one in the middle of each timber, are driven first, and from the inside, in order to draw the materials well in contact with the frame timbers, and the remaining bolts from the outside.

Water-courses are cut wherever there is a probability that water would otherwise lodge, particularly at the ends of the fore-and-aft pieces and trusses, also at the ends of the diagonal timbers if they abut against the limber strake, or the keelsons in wake of the main mast: these water-courses are formed by cutting off the angle, with a plain chamfer, of about four inches at the perpendicular and five inches at the lower part; the same principle is observed with respect to the hooks, crutches, &c.; but it is then carried to a greater extent.

Trusses of iron.—Although many frigates have been built with a diagonal framing in their holds, similar to that in ships of the line, and which was found to answer the intended purpose extremely well, yet it has not been practised in this class of ships for the last three years. Instead of this framing the afore-mentioned iron straps (*Plate* O, ref. o,) are placed in a diagonal direction at an angle of about forty-five degrees, to act as trusses *; these are fitted to lie close to the inside planking over which they run, with the exception however of the two strakes of thickstuff (*Plate* O, ref. L L,) which are worked over the joints of the timbers, and which are scored down upon the iron trusses. For conveniency in rolling the iron straps, and also to make them set closer to the timbers, they are generally worked in two lengths, the upper part of the strap giving a scarph of about five feet to the lower; for their dimensions, and also for those of the thickstrakes, the reader is referred to the scheme of scantlings. The iron trusses are laid six feet asunder, the three foremost and the three aftermost ones run to the underside of the upper-deck, the remainder to the underside of the lower-deck only, and all extend to about five feet below the floorheads. The bolts for their security and attachment to the frames of the ships are

* Although the author agrees generally in the doctrine laid down by Mr. Morgan, and inserted from page 12 to page 16, with regard to the diagonal framing, yet he differs from him in the position, that the iron straps should be laid as braces, considering that they are more efficacious when placed, as recommended by Sir R. Seppings, to act as trusses.

of seven-eighths of an inch diameter, and placed from eighteen to twenty inches apart; a bolt, however, is driven within four inches of each end.

Orlop, strake under the beams.—The orlop beams in ships of the line have a fore and aft strake, four inches thick, placed under them in midships, to receive the heads of the pillars in hold.

Half beams.—The half beams are all of fir except those in the cable tiers which are of oak. A piece of plank is wrought on the end of each half beam to make it of sufficient depth to reach the shelf piece; the midship end of each half beam is secured to a carling, lying in a fore and aft direction, by means of a dog bolt.

Shelf Pieces.—The dimensions of these are given in the scheme of scantlings. The inner edges of the shelf pieces are placed lower than the edges next the clamps, to prevent water from lodging on their upper sides. Their scarphs are five feet six inches long, and have four coaks in each; the scarphs are so disposed that the front lip shall over-run the chock under the shelf piece about four inches. The shelf pieces are secured with bolts placed from one foot six inches to one foot eight inches asunder; and as the throat bolts of the iron knees pass through the shelf pieces, no other bolt is placed nearer than one foot to the middle of each chock intended to receive an iron knee. The diameters of the in-and-out and up-and-down bolts for shelf pieces are as follows:—

	Ships of the Line.	Frigates.
	Ins.	Ins.
Orlop	$1\frac{1}{4}$	1
Lower-deck	$1\frac{1}{4}$	1
Middle-deck	$1\frac{1}{8}$	
Upper--deck	$1\frac{1}{8}$	$1\frac{1}{8}$
Quarter-deck and Forecastle	1	$\frac{7}{8}$
Roundhouse	$\frac{7}{8}$	

The following are the diameters of the coaks for the shelf pieces, and also the number placed in each beam end :

		Ships of the Line.		Frigates.	
		Ins. diam.	No.	Ins. diam.	No.
Each beam end and shelf piece.	Orlop	4	2	$4\frac{1}{8}$	1
	Lower-deck	$4\frac{1}{2}$	2	$4\frac{1}{2}$	1
	Middle-deck	4	2		
	Upper-deck	4	2	4	2
	Forecastle and Quarter-deck	$4\frac{1}{2}$	1	4	1
	Roundhouse	4	1		
Each half beam end and shelf piece.	Orlop	$4\frac{1}{2}$	1	3	1
	Lower-deck	$4\frac{1}{2}$	1		
	Middle-deck	4	1		
	Upper-deck	4	1	$3\frac{1}{2}$	1
	Forecastle and Quarter-deck	4	1	3	1

These coaks are four inches long, hollow and of cast iron, the cavity is filled with cement and sand.

Chocks under the shelf pieces.—At the situations where those beams rest which do not come over the ports, chocks are placed; upon these the faces of the iron knees rest and are bolted. The chocks of the orlop shelf pieces are so placed that the bolts of the diagonal timbers pass through them. The chocks under the gun-deck beams in ships of the line, extend to the orlop beams to which they are attached by a side plate. (See *plate* K, *fig*. 3.)

Iron Knees.—The beams of the lower, middle, upper and quarter-decks, and forecastles of ships of the line, are attached to their sides by iron knees, those which do not come over the ports, with clasp knees, their vertical or up-and-down arms being bolted through the chocks and sides, and their clasp arms through the beams, (*Plate* K., *Fig.* 5.) one of the bolts in the throat of the knee being placed vertically; those which come over the ports, by iron dagger knees, the upper arm placed and fastened against the sides of the beams, having also an ear projecting to receive a bolt to pass through the ship's sides, the lower arm is bolted on a chock placed diagonally against the ship's sides. The beams of the round house are secured with a plate bolt only, the diameter of the bolt part, which passes into the beam, and is clenched on an iron plate, is one inch and a half; the plate part of the bolt is fastened to the ship's side with bolts of seven-eighths of an inch diameter.

The diameter of the bolts for forked knees is as follows:—

LOWER-DECK.

	Inch diam.
The two throat-bolts and the up-and-down bolts	$1\frac{3}{8}$
The lower bolts, and those which run fore and aft into the beams	$1\frac{1}{4}$

MIDDLE AND UPPER-DECKS.

The two throat and up and down bolts	$1\frac{1}{4}$
The lower bolts and fore and aft ditto	$1\frac{1}{8}$

QUARTER-DECK AND FORECASTLE.

The two throat and up-and-down bolts	$1\frac{1}{8}$
The lower bolts and fore and aft ditto	1

In frigates, the lower-deck beams are secured at each end with an iron knee placed under them and fastened with bolts one inch in diameter. The beams of the orlop and platforms, as well as the foremost and aftermost beams of the lower-deck, are secured with three bolts of one inch and one-eighth diameter, driven diagonally from the upper side into each of their ends through the bottom; one at least of which passes through the shelf piece.

Trussing between the Ports.—The horizontal planking, called quick-work, introduced in ships of the line in the old, is omitted in the new system of ship building, and abutment pieces and trusses are worked in its stead. The abutment pieces for the gundeck are about thirteen inches in breadth, and for the middle and upper decks twelve inches only.

The trusses for the gun-deck are eleven inches, and for the middle and upper decks ten inches in breadth; the abutment pieces exceed those in breadth two inches, and are of the same thickness as the clamps, if they do not exceed six inches, in which case they are not bearded, but if they exceed that thickness they are bearded to six inches: the diagonal trusses are half an inch less in thickness than the abutment pieces.

Every abutment piece is coaked to the port timber, with one coak of three inches and a half diameter, which is so placed as to act against the pressure of the truss on the abutment piece, the ends of each abutment piece are bolted with two in-and-out bolts of seven eighths of an inch diameter; they are also bolted in a fore and aft direction with one bolt in each of the same diameter. The space between the trusses and abutment pieces is left open while the ship remains in a state of ordinary to give air to the frame, but when put into commission it is covered over with sheet copper.

Waterways.—The waterways are rounded in front, and have a rabbet to receive the flat of the decks, this rabbet is so cut as to admit of a seam for caulking of three inches in depth, and at such an angle that the buts of the flat of the deck may be bearded three-eighths of an inch. And to prevent a lodgment of water on the upper side of the waterways, they are canted below a level from the timbers inwards. The waterways are wrought in short lengths, and butted on carlings, let down for that purpose between the beams; these carlings are let into scores which are taken out of the beams and half beams. These are of the same breadth as the waterways, and of the same depth as the binding strake, the upper side of the carlings are flush with the upper side of the beams. Each but of the waterways is secured to the carling with two coaks, and one up-and-down bolt, the bolt passes also through the shelf piece. The waterways and their ekeings are scored down on the beams and half beams; the scores for the gundeck (in ships of the line) are three inches; for the upper deck two inches and a half; the scores at the beam are taken from the waterways and ekings, and the buts are faced on the sides of the beams half of an inch, but at the half beams the scores are taken from them and not from the waterways.

One up-and-down bolt in the waterways, and through the shelf piece is placed in each end of the beams and half beams; the diameter of the bolts for the beams of the gundeck is one inch and a quarter, and for the middle and upper decks one inch and one-eighth, for the half beams of the gun-deck one inch and one-eighth, and for the middle and upper decks one inch. The in-and-out bolts in the upper part of the waterways are the same in number as those in the binding strakes, the diameter of the bolts in the gun-deck one inch and one-eighth, and for the middle and upper decks one inch.

The diameters of the coaks, which are of cast iron, four inches in length, and the number placed in each beam are as follows :—

	No.		diam.
In each beam end and waterway on the lower-deck . .	2	coaks	4 ins.
Ditto middle and upper-decks .	2	,,	$3\frac{1}{2}$,,

Waterways coaked for Decks laid fore and aft.—The coaked waterways for the lower decks of frigates are ten inches and a half square, the quarter decks of all ships ten inches and a half, and the round-house nine inches square ; a rabbet is taken out of the waterways so as to admit of there being a seam of three inches deep for the purpose of its being caulked. These waterways are fastened on the lower decks of frigates, and on the quarter-decks and forecastles of ships, with bolts of one inch diameter, and on the roundhouses of all ships with bolts of seven-eighths of an inch diameter. The up-and-down bolts in the waterways and half beams are one-eighth of an inch less than those placed in the main beams. The in-and-out bolts are placed from one foot eight inches to two feet asunder; each beam end is united to the waterway by cast iron coaks of the diameters following :—

	Ships of the Line.		Frigates.	
			diam.	
Lower-deck			$3\frac{1}{2}$ ins.	1 No.
Forecastle and Quarter-deck . .	4 ins.	1 No.	4 ,,	1 ,,
	diam.			
Roundhouse	$3\frac{1}{2}$,,	1 ,,		

Thin Waterways.—These are one inch more in thickness than the flats of the respective decks, and are fastened to the beams and half beams with treenails, with the exception of their buts which are secured with mixed metal nails.

Binding strakes at the side to secure diagonal Decks.—The side binding strakes for the gun-deck are six inches in thickness, for the middle and upper decks five inches, and are in breadth for all the decks ten inches; they are let into scores taken one half of the thickness of the binding strakes, from the beams and half beams, and the other half from the binding strakes; the scores are faced half of an inch on the sides of the beams. In frigates the binding strakes are five inches thick, and scored and bolted in the same manner as in ships of the line.

Binding strakes in Midships.—The midship binding strakes are coaked to every beam and breasthook, with one coak three and a half inches diameter. These strakes are five inches thick before the aft part of the fore hatchway for the gun-decks of ships of the line, and four inches thick from the ward-room bulkhead forward for their middle and upper-decks, and also for the upper-decks of frigates; the remainder is the same thickness as the decks.

Diagonal Decks.—The gun-deck, middle and upper-decks of ships of the line, and the upper-decks of frigates, are laid diagonally at an angle of forty-five degrees with the beams. Every side but of the decks so laid is fastened to the binding strake at the side, with two treenails of one inch and a half in diameter; except in those beams where the up-and-down bolts in the forked knees, or the bolts for the half beams described below, pass through the flat of the deck, then one treenail only is driven. Two treenails also pass through each half beam, and one through each diagonal ledge.

Every midship but is fastened to the beams or to the carlings with two bolts, and every plank is fastened to each beam, that it may cross with two bolts also; the bolts are eleven inches long and five-eighths of an inch in diameter on the gun-deck, and eight inches long and five-eighths of an inch in diameter for the middle and upper-decks; the holes are bored quite through the beams to admit of the bolts being driven out on the repair of the ships. One up-and-down bolt passes through the flat of the deck, the side binding strake and each beam and half-beam, except those beams where a throat-bolt to the forked knees are placed; on the gundeck, these bolts pass through the shelf-piece; the diameter of the bolts on the gun-deck are one inch, those for the middle and upper-decks seven-eighths of an inch. The forecastle, waist, and quarter-deck of ships of the line and frigates are fastened with mixed metal nails.

Sterns circular.—The mode of timbering of these sterns assimilates to that practised in the bow, and as many timbers as possible run up to the top of the side (see *plate* K, *fig.* 4,); the stools, decorations and fittings, depend upon the taste and judgment of the persons who may superintend the works, and more properly belong to the ship-joiner than the naval architect.

The aforegoing instructions have been confined to the mode of building ships of the line and frigates. In small vessels the frame is made solid as high, or nearly so, as the line of fluitation, and a thick strake worked over the joints of the timbers; the beams of their upper-decks are secured to the sides by being coaked and bolted to the shelf pieces and thick waterways, those of the lower-deck by a shelf piece under the beams to which they are coaked (the thick waterway being omitted), and bolts pass in a diagonal direction through the ends of the beams, the shelf piece and bottom; two or three iron knees, according to the respective sizes of the vessels are placed under the upper-deck beams on each side in wake of the masts. These are the distinguishing differences from the old mode of ship-building, which have been introduced into the smaller classes of vessels by Sir R. Seppings; the dimensions of their timbers, planks, *&c.*, are given in the scheme of scantlings.

It is universally acknowledged, that, however well a ship may be put together, or however good may be the principle on which she is constructed, these are defeated if decay of the materials speedily takes place. Every means then are used to prevent the decomposition of the timber. The ships are built under permanent roofs: these were put up at the recommendation of Sir R. Seppings, the framing of most of them is upon his principle of trussing, and they are generally admired for their strength and lightness. To prevent decomposition from moisture, an intervening coating, such as paint or coal tar is put upon the faying surfaces of the timbers, beams, *&c.*, and all chips and saw-dust are removed from the openings. But, as it is foreign to the subject matter of this work to enter into a detail of these particulars, the reader is referred to a recent publication*, in which all these precautionary measures are treated at large.

* Knowles "On preserving the Navy," chapter VI.

SECTION III.

ON THE CONSTRUCTION OF SHIPS EMPLOYED BY MERCHANTS IN COMMERCE.

THAT no nation can become formidable to its neighbours as a naval power, without being commercial, is a fact which must be admitted by all those who have given the subject any attention. The revenue which commerce affords, the activity which it promotes in the manufactories of the various kinds, the excellent officers and seamen which it gives to the country for her defence in times of need, not only advance the general interests of the community, but support the best bulwark of Great Britain, the Royal Navy.

The advantages which the state has derived from the diagonal method of ship-building, induced the inventor, with that spirit of benevolence and enterprise for which he is so distinguished, to turn his attention to the construction of merchant ships, and to bring forward a plan which should combine economy in the building of those vessels, with safety to the mariners and security to the merchandise. This plan has been, in some degree, followed by merchant ship-builders. Messrs. Fletcher and Fearnall, at Limehouse, in the river Thames, have constructed several ships having the materials in their holds laid in a diagonal direction. Mr. Tibbet, of the same place, launched the Atlas, of 400 tons, in the year 1819, which had been constructed on this plan. Mr. Tindell, of Scarborough, built at that port the Africa of 400, and the Euphrates of 500 tons, in which he had introduced, very generally, the diagonal method of ship-building. These are, however, the only instances which have come within the knowledge or inspection of the author in which the system has been introduced by merchants; but, as the principle becomes better understood, and the advantages of this mode of ship-building more generally known, it will no doubt be practised to a considerable extent. It remains then to give a descriptive account thereof, in the author's own words *.

"Firstly, as to the principle on which mercantile ships are at "present built, and particularly as regards the putting together their "ribs or frames, and the arrangement of the materials.

"In forming the frames or ribs, half of the timbers only are united, "so as to constitute any part of an arch; every alternate couple "only being connected together: the intermediate two timbers "(termed fillings) being unconnected with each other, and merely "resting upon the outer planking, instead of giving support to it. "Now, it must be very evident that ships, so constructed, can by no "means possess equal strength with those that have the whole of "their timbers formed into frames or arches.

"This loose practice is, I believe, peculiar to the English mer-"chant ship-builder; and indeed was pursued till very lately even "in His Majesty's Navy, while the preferable system of connecting "the ribs was common to other maritime powers.

"The principle of uniting the frames, lately introduced in the "construction of English ships of war, might, no doubt, be also "introduced into the mercantile navy; which would give to the "ships in that employ additional strength and increased durability, "without adding to the expense of building.

* Philosophical Transactions for the year 1820.

" But the present mode of joining together the several pieces of " the same rib, is also highly objectionable. It is done by the " introduction of a third piece, technically termed a *chock* or *wedge* " *piece*, (Pl. M., Fig. 1., marked A,) of which pieces the number " amounts to upwards of 450 in a 74 gun ship, and not less than that " number in an Indiaman of 1,200 tons: (to which class of ships the " drawings in this statement have reference.) Of these chocks not " one in a hundred is ever replaced in the general repair of a " ship; for they are not only found defective, but very generally " to have communicated their own decay to the timbers to which " they are attached. Besides this, the grain of the rib-pieces " being much cut, to give them the curvature required, has a con- " siderable share in weakening the general fabric. That they " occasion a great consumption of materials, is obvious, as the ends " of the two rib-pieces must first be cut away, and then be replaced " by the chock.

" This mode of putting together the frame, is also peculiar to the " English ship-builder; and I find, from an old work in my pos- " session, dedicated to George the First, that the practice was " introduced in the construction of English ships about the year " 1714; and having heard that so unfriendly to it was the builder " (Mr. Naish) of the Royal William, that he refused to adopt it; " and being desirous of ascertaining the fact, when that ship was " taken to pieces at Portsmouth, in 1813, I found that she was built " without the wedge pieces or chocks, to which, in a certain degree, " I ascribe her strength and durability; her ribs being by her " structure less grain-cut, and for want of chocks, less liable to " decay in those parts where they are inserted.

"The introduction of chocks, was no doubt to procure that cur-
"vature which is so necessary in the formation of a ship, when
"crooked or compass timber became scarce; as may be seen by
"Pl. M., Fig. 2., which describes the shape of a piece of timber in
"the converted form; and by which it will also be seen, that the
"introduction of the chocks assists in obtaining the required curve.
"But this curve may equally be obtained by a different combination
"of materials, and at a considerable less consumption of useful
"timber.

"The frames of a mercantile ship (on the present mode of
"building) before they are placed and united to each other, may be
"seen in Pl. M., Fig. 3, with their chocks or wedge-pieces. To
"the evils already stated of the present practice, may be added
"that of imperfect workmanship, so that the surfaces of the chocks
"are seldom in contact with those of the timbers; and the ends of
"both are frequently reduced so thin, as to split by the fastenings
"that are necessary to secure the planks to the ribs; and thus the
"ship, in the event of grounding, or even in the act of rolling,
"derives little support from timbers united only, in fact, by two
"narrow edges.

"Another great defect arising out of the present plan of con-
"structing mercantile ships is, that the ends of the lower ribs or
"timbers, commonly termed the lower futtocks, (Pl. M., Fig. 3. B,)
"are not continued across the keel C, so that no support is given
"in a transverse direction when the ship touches the ground; nor
"any aid to counteract the constant pressure of the mast. This
"great sacrifice of *strength* and *safety* is made for no other purpose
"than that of giving a passage for the water to the pumps.

" The floor timbers, which by this mode of construction are the " only timbers that cross the keel, are also weakened for the same " purpose, as shown at D, Pl. M., Fig. 3. This mode also makes " the conveyance of the water very uncertain, for the passage is not " unfrequently choaked; and the pumps (from its not being prac- " ticable to continue them sufficiently down) always leave from six " to eight inches of water in the ship; so that these compartments " constantly contain a certain quantity of putrid bilge water, " offensive and injurious to the health of those on board.

" The deficiency of strength causes also an alarming insecurity " in the plank of the bottom, as shown at E, Pl. M., Fig. 3., termed " the garboard strake; which consequently, has no other fastening to " the general fabric, than its connexion with the keel at F, Pl. M., " Fig. 3., and a slight security at G. Pl. M., Fig. 3.: hence it is ob- " vious, that in the event of the keel being disturbed, the garboard " strake, from its being attached to it, must share the same fate as the " keel, and in that case the loss of the vessel would be inevitable.

" To obviate these serious defects, is the principal object of this " paper.

" The principle I would recommend is explained in Pl. N., Fig. 4., " by which it will be seen, that the component parts of each rib are " of shorter lengths and less curvature, and consequently less grain- " cut; that they are more firm and solid by the substitution of coaks " or dowels, for chocks or wedge-pieces; and that the mode of con- " necting the lower timbers is better adapted, in the event of a ship " grounding, to give support and strength to the fabric, as will appear " by the line marked H.

" The plan of connecting the ends of the timbers by circular dowels

" or coaks (as at I,) is simply that which has, from time immemorial, " been practised to unite the fellies of carriage wheels.

" I was prompted to attempt the introduction of the plan of building " ships of war with small timber united, as before mentioned, from a " conviction, that a well combined number of small timbers, might be " made equal, if not superior, both in strength and economy, to the " large, overgrown, and frequently grain-cut materials, made use of in " constructing the frames of large ships; and the result has shown the " correctness of the principle; the adoption of which cannot fail to " prove of great national advantage, in the application of sloop timber " to the building of frigates, and of frigate timber to ships of the line, " whenever larger timber cannot be procured. On this principle also, " may frigates and small ships of war, or merchant vessels, be built of " straight fir, without the assistance of oak or elm*, which were for- " merly employed to give the necessary curvature of the sides. As it " respects the general safety of the ship, it will be seen, by Fig. 4 and " 5, Pl. N. and O., that the timbers uniformly cross the keel; that the " frame of the ship is filled so as to form one compact body to the " height marked K.; and that only certain internal strakes of plank, " or thickstuff, as it is termed, are introduced, which are those on the " joints of the timbers, for the purpose of giving strength where " every alternate timber necessarily joins, as shown at L (Pl. O). All " the rest of the inner planking may be omitted; and dunnage bat- " tens, brought in a perpendicular direction, upon the timbers *between* " the plank, as shewn at M, forming regular spaces between each,

* This has recently been carried into effect in His Majesty's ship Niemen, of 28 guns, built in Woolwich Yard of fir.

J. K.

" as is usual at present *upon* the plank; thereby giving an increase " of stowage in proportion to the thickness of the plank omitted. " Water-courses, as shown by dotted lines at N, are to be left in the " joints of the timber under the plank, for the purpose of conveying " the water to the pumps; which, by this plan, will reach below the " water, instead of being some inches above, as is the case with the " present mode, before described; consequently, by the proposed " system, no stagnant water will remain; and farther, the limber " passage, or water-course, will be one smooth, uniform channel, " which can be cleared with ease, should it be required, whenever " the hold is unstowed; whereas at present it is inaccessible in " places, and forms compartments for putrid water, without there " being any means of removing it.

" It is obvious, that a ship on the principle I have here recom- " mended, may sustain the loss of certain planks of the bottom, and " also the keel, (which has frequently been found to have happened " to ships of war on their being taken into dock,) and still reach the " place of her destination; when the loss of *either*, would be the " destruction of a ship built on the present mode. It will be evident " also, that a ship constructed as now recommended, possesses " greater stowage, and more space for leakage, than by the old " plan; by the omission of the useless inner planking, and by laying " the kentlage on dunnage, leaving a space for the water, which was " formerly occupied by the inner lining. This dunnage in the bilge " may be formed with the iron kentlage, and thereby serve as ballast, " for which it is well calculated from its situation; and by its occu- " pying a space heretofore forming part of the fabric of the ship, " will give an increase of stowage, as before stated.

" The best mode of closing the openings between the timbers, is " by filling the intermediate spaces with pieces of wood, about three " inches in depth, of such lengths as the inferior conversions will " supply, abundance of which may be procured from the offal. " These fillings are to be well caulked, after which the exterior " plank is to be brought on. When the works are going on within " board, similar pieces are to be fitted internally, and afterwards " taken out for the purpose of filling the spaces between the pieces " so fitted, with a mixture of PARKER's Roman cement and drift sand, " in the following proportions, *viz.*:

" PARKER's Roman cement, $\frac{2}{3}$
" Drift sand, ... $\frac{1}{3}$

" previously paying the opening well with coal tar. Where there " is sufficient space a brick, or part of one, may be introduced, pro-" vided there is room for cement between it and the timbers. When " filled in to within about two inches of the surface of the frame, the " pieces of three inches already fitted and taken out, are to be well " driven in and caulked, and by so doing no space will be left un-" occupied. If considered desirable, these pieces may be driven " below the surface of the timber, thereby leaving water-courses to " convey the leakage to the pumps in channels. And prior to " launching or undocking of ships, built on the principle I have " recommended, it has been the practice to inject the part filled in " with mineral tar, by means of a simple forcing pump, boring holes " in the joints of the timbers for the introduction of the pipe*. By

* This plan of injecting with coal tar, can only be followed in ships whose cargoes are of such a nature, as not to be liable to injury from the effluvia which arises from that article, when used in its raw state. It is now, however, the practice in His Majesty's service, to fix the tar upon the timbers of ships, by a mixture

"following this method, the air will be excluded, which, as experience has shown, tends much to the durability of the fabric. "If what is here recommended be attended to, and mercantile ships "were built under roofs, as ships of war now are, durability would "be obtained in addition to safety, from the mode of their construction.

"The beams are to be attached to the sides, as shown at O, "Pl. N, Fig. 5, rendering wood knees unnecessary, and requiring "only a small number of those of iron.

"Plate P, marked P, describes the old principle of framing the "stern with transoms. Q, the new principle, with timbers similar "to the bow, omitting the transoms below the wing or upper "transom; and by introducing the new principle on which the floors "are made, the necessity of using valuable compass, or crooked "timber, hitherto required, and with difficulty procured for these "purposes, is avoided. Uniform support will thus be given, and "also an increase of room for stowage.

"In large mercantile ships above 500 tons, I would recommend that plate-iron be laid diagonally, as shown in Pl. O, marked O.

"The principle now recommended will cause a decrease in the "consumption of materials, and the difficulty of procuring the "necessary curvature will be obviated. It also affords protection

(by measure) of two thirds of coal-tar and one third of slacked lime, which, by chemical affinity, readily unites with the tar, and this hardens shortly after it has been mixed. Whiting well dried and finely pulverized, mixed with linseed oil, in the proportions (by measure) of three-fifths of the former, and two-fifths of the latter, is an excellent substitute for the tar and lime, and not liable to the objection which has been advanced against it; with this, the bread-rooms in His Majesty's ships are now injected.

J. K.

" from worms externally, and vermin internally. Leaks may be " more easily discovered and stopped than by the old method; and " in point of additional strength, there can be no doubt."

In adopting the plan of the diagonal braces and trusses in some merchant ships, an incorrect disposition of the materials has taken place, by laying the longer pieces in a direction to act as trusses, and the shorter ones as braces. This has been done from the notion that, as the greater proportion of the cargo is placed in midships, the weight thereof being so much more than that of the water displaced, those ships have a tendency to *sag*, or in other words, for their extremities to rise and their midship bodies to depress, an alteration in figure the very reverse of which is found to be the case in ships of war. The reasoning would be correct if the ships were constantly at rest in still water; but as this is not the case, being subjected at sea to the motions of rising and pitching, or leaving their extremities unsupported, while their midship bodies are waterborne, the same effects, of arching or hogging, constantly take place, as are found in ships of war built after the old methods.

The laying then of the diagonal framing in the direction practised in ships of war, and pointed out in the preceding part of this Appendix, is a consideration of primary importance.

It would appear that the method of a diagonal framing, as formerly introduced in the frigates of 60 guns, is admirably adapted for the ships belonging to the East India Company; no loss of stowage would be experienced, and great strength, with safety to the mariners and cargo, would be gained thereby. For, when we examine the East India Company's ships of the largest class, built according to their present methods, as it respects the forms of their bodies below the line of fluitation, the relative proportions of breadth to length, and above all, the method of forming the water-course by the floors, we must pronounce them to be in every respect unsafe, and ill adapted for any other purpose than that of carrying at a great sea-risk, a large cargo with comparatively small tonnage, and this advantage arises only from the present faulty and imperfect method of casting the tonnage of ships. Notwithstanding the constant loss of these ships, yet experience so dearly bought has not tended in any way to change established custom.

The fact, that if an East India ship go ashore in bad weather, she often breaks her floors, and generally fills with water, has not been sufficient to work any change against deep-rooted prejudices. But it is to be hoped that, as the insecurity of the bottoms of these ships becomes more generally known, the voice of reason, and indeed of humanity, will not be raised in vain.

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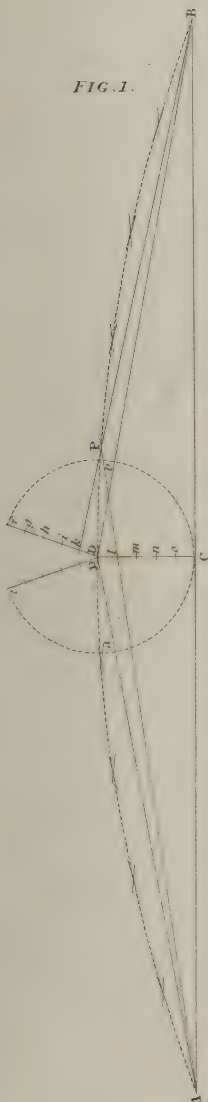
CLEATS.

FIG. I.



CONSTRUCTION OF AN ARCH, OF LARGE RADIUS.

FIG. III.

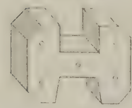


FIG. IV.

FIG. V.

FIG. VI.

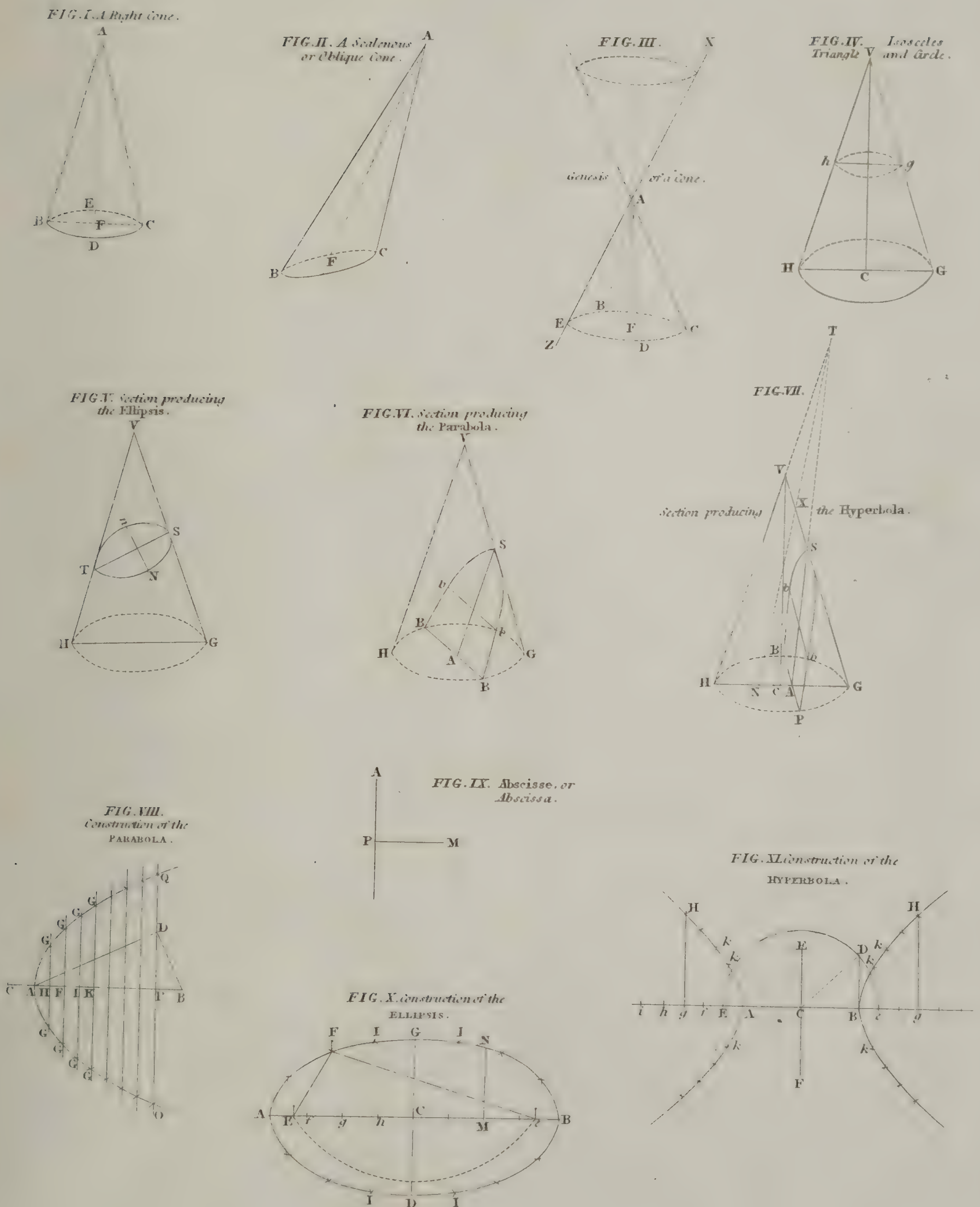
FIG. II.

A CIRCLE,

WITH ITS RELATIVE TERMS AND PROPERTIES.

(PLATE B.)

CONE. – CONIC-SECTIONS.



(PLATE C.)

Capt.ⁿ Hamilton's Improved CAPSTAN.

Fig. 1.

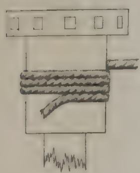


Fig. 2.

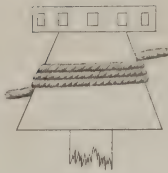


Fig. 5.

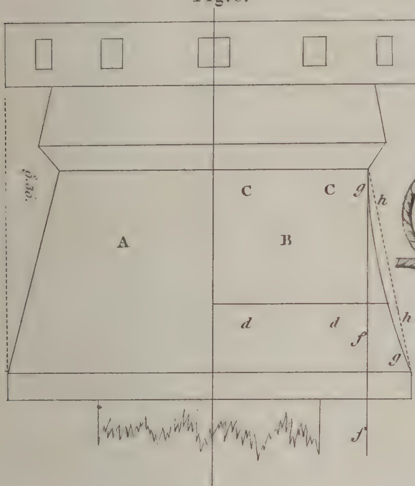


Fig. 3.

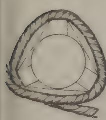


Fig. 4.

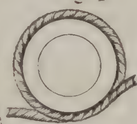
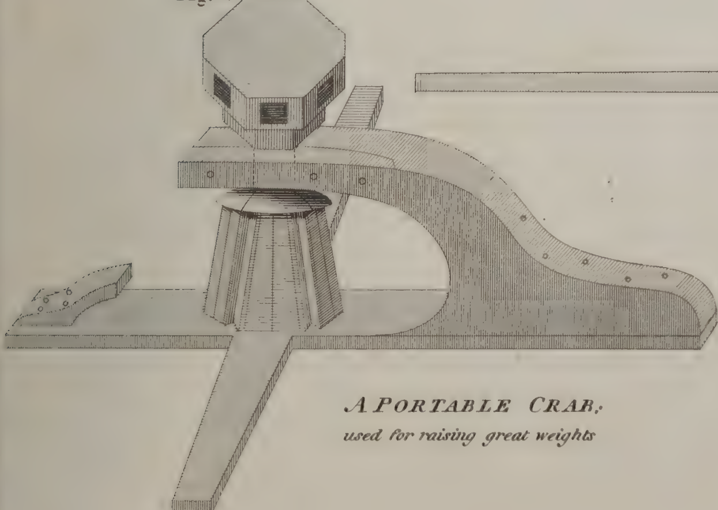
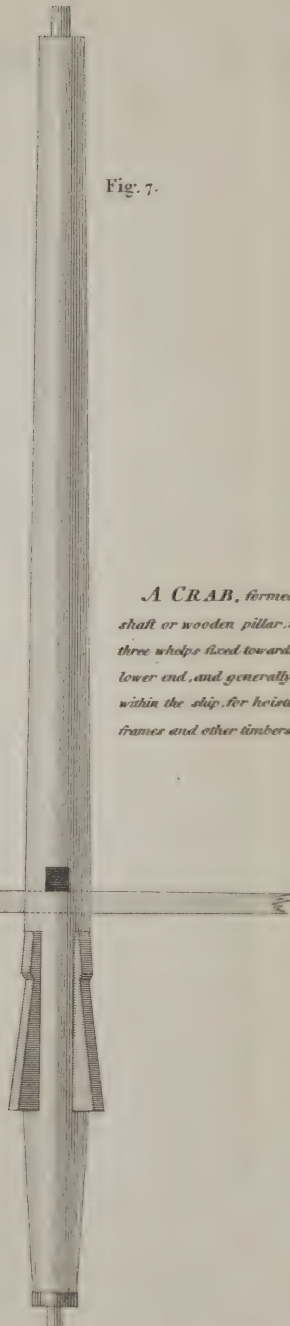


Fig. 6.



A PORTABLE CRAB, used for raising great weights

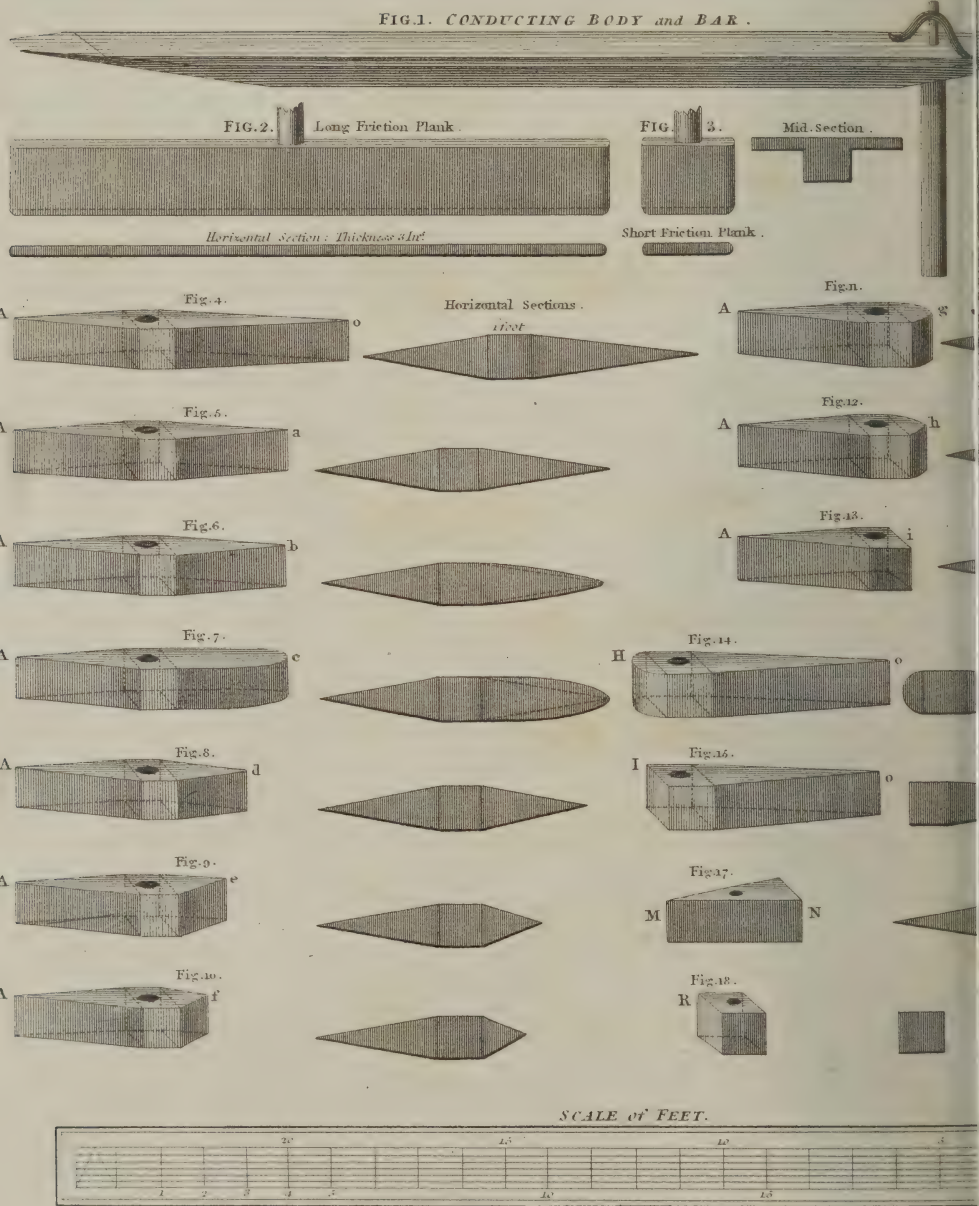
Fig. 7.



A CRAB, formed of a shaft or wooden pillar, having three whelps fixed towards its lower end, and generally used within the ship, for hoisting the frames and other timbers &c.

REPRESENTATION of the CONDUCTORS and BO

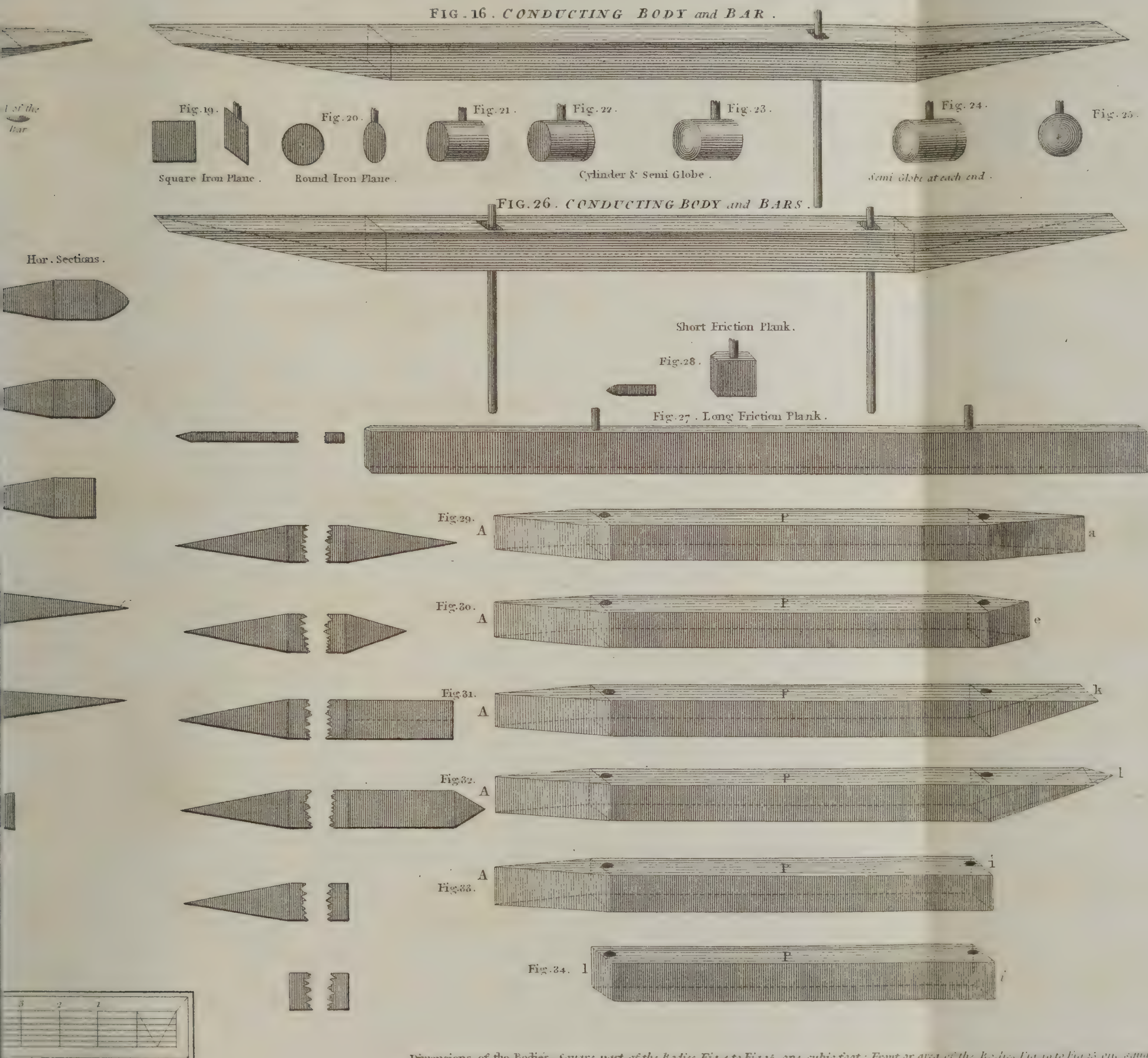
the IMPROVE



(*PLATE D.*)

ES used in the EXPERIMENTS made by Order of the SOCIETY for

ENT of NAVAL ARCHITECTURE.

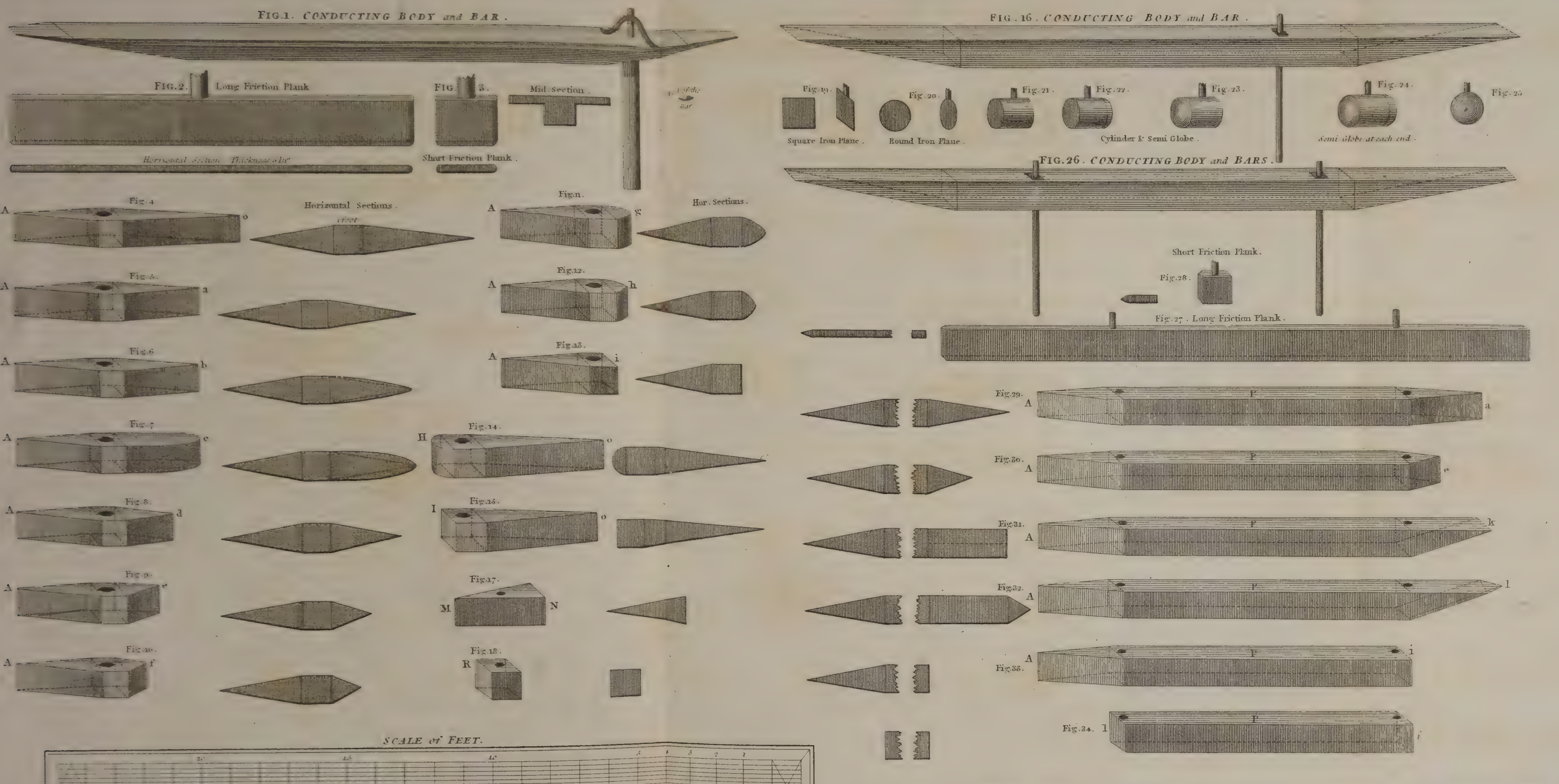


Dimensions of the Bodies_ *Square part of the Bodies Fig. 4 to Fig. 15. one cubic foot : Front or area of the Bodies Fig. 19 to Fig. 25 one square fee*

Middle part of the Bodies, or parallelopiped P. Fig. 29 to Fig. 34. 10 feet long, one feet broad and one feet deep. –

(PLATE . D.)

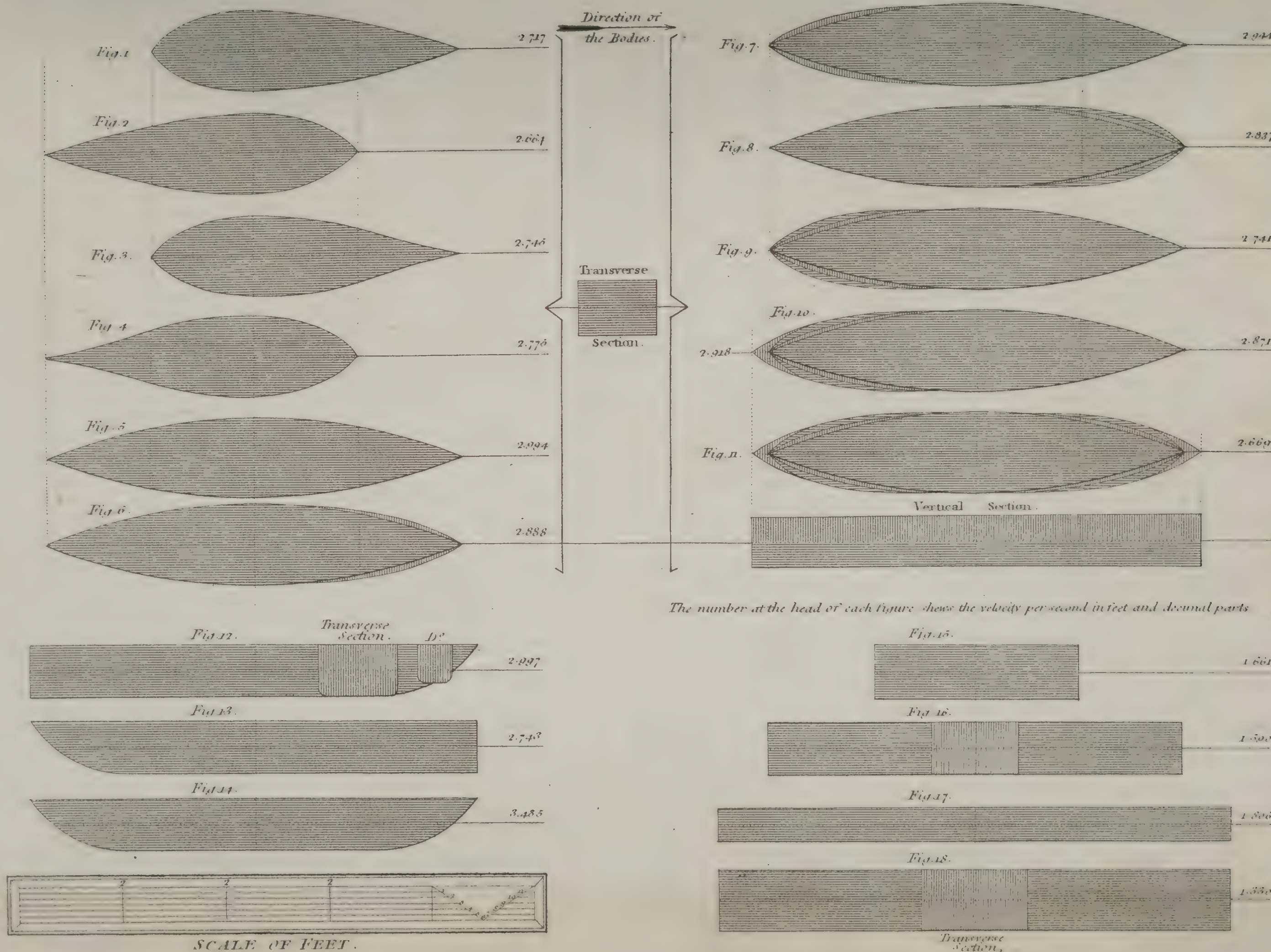
REPRESENTATION of the CONDUCTORS and BODIES used in the EXPERIMENTS made by Order of the SOCIETY for the IMPROVEMENT of NAVAL ARCHITECTURE.



Dimensions of the Bodies. *Square part of the Bodies Fig. 4 to Fig. 15. one cubic foot: Front or area of the Bodies Fig. 19 to Fig. 25. one square foot: Middle part of the Bodies, or parallelopiped P. Fig. 29 to Fig. 34. 10 feet long, one foot broad, and one foot deep.*

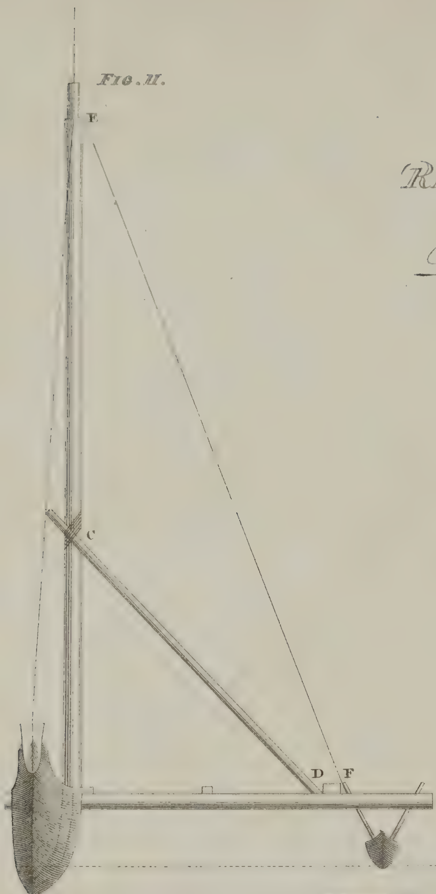
(PLATE - E.)

EXPERIMENTS ON FLOATING BODIES.

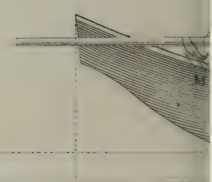


The number at the head of each figure shews the velocity per second in feet and decimal parts

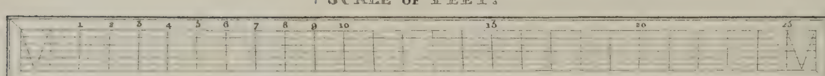
FIG. II.



REPRESENTATION of a FLYING PROA
Taken at the Ladrone Islands,
By Commodore, afterwards Lord Anson



SCALE OF FEET.



.F.

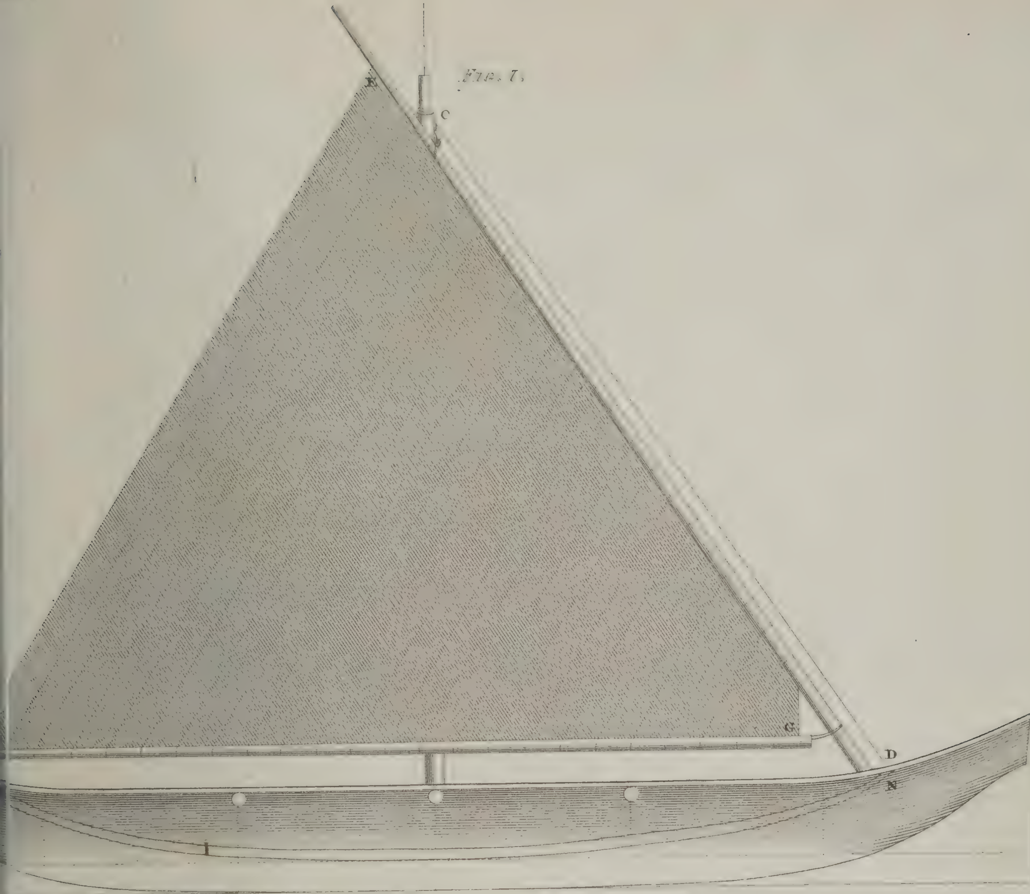
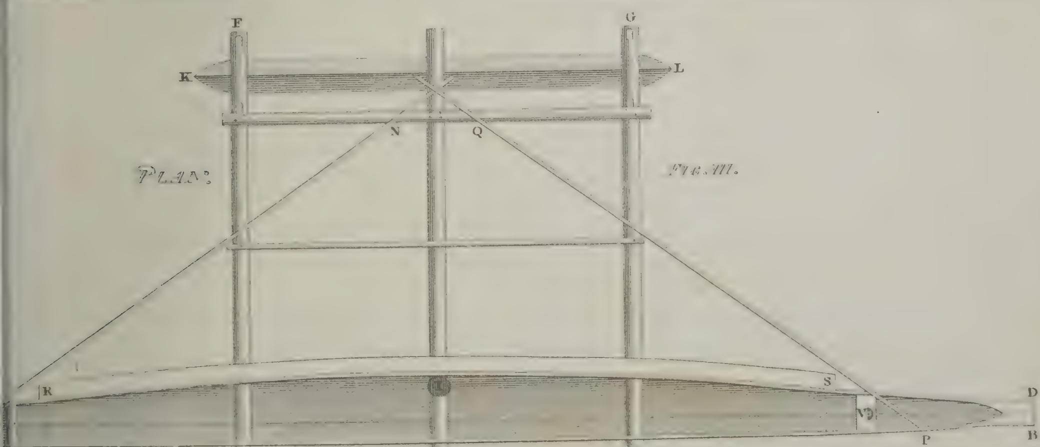


Fig. I.



Plan.

Fig. III.

(PLATE - G.)

EXPERIMENTS on STABILITY.

FIG. I.

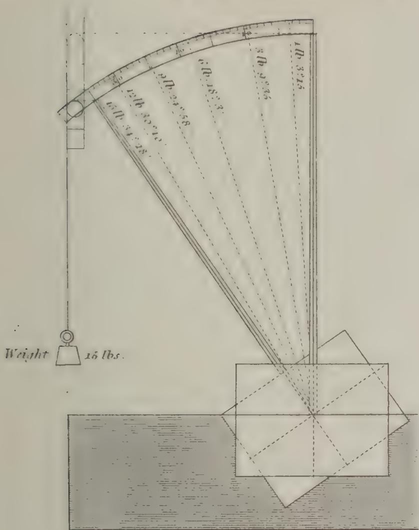


FIG. III.

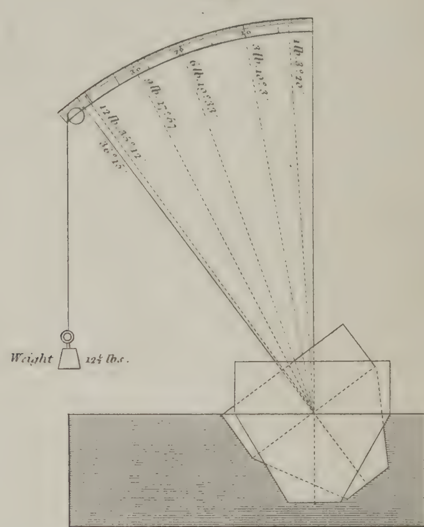


FIG. II.

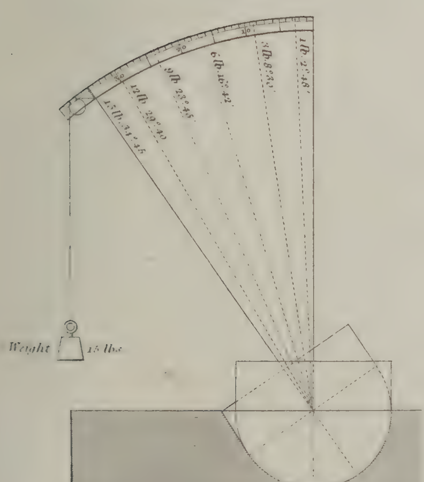
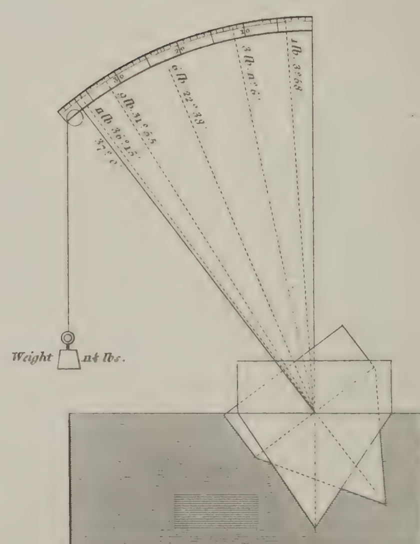


FIG. IV.



Dimensions of the Figures *three feet in length and two in breadth.*

(PLATE II.)

FIG. I. SCALE of SOLIDITY or TONNAGE.

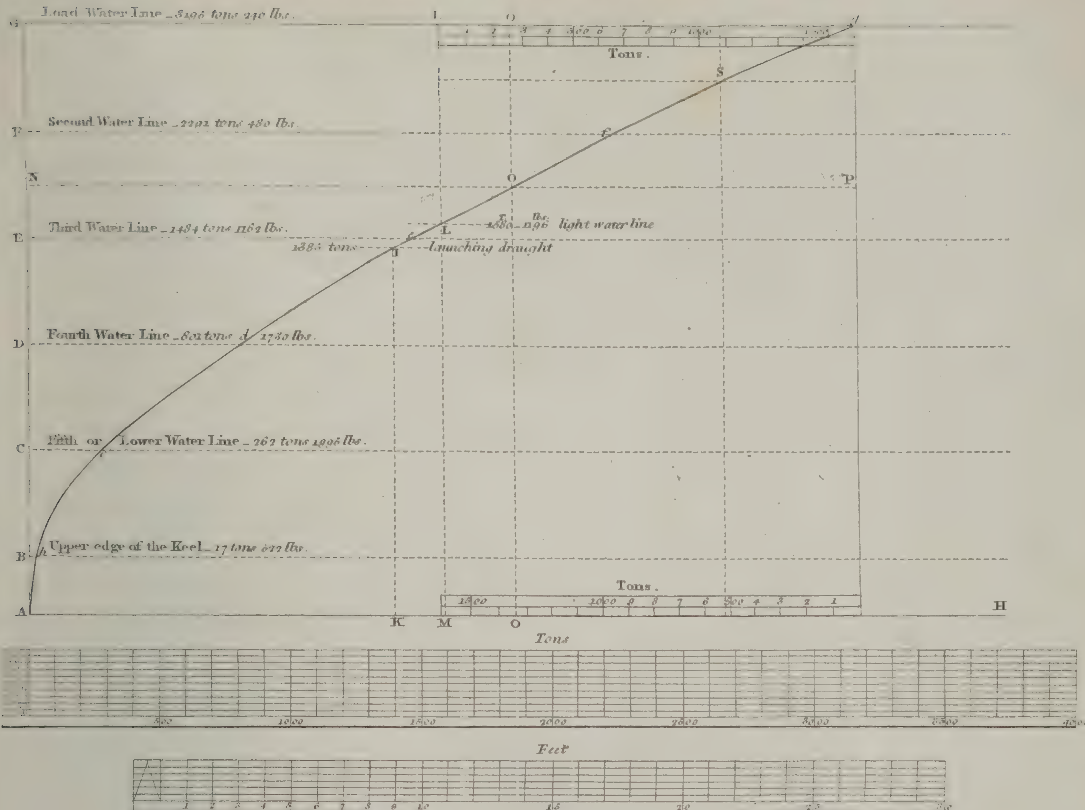
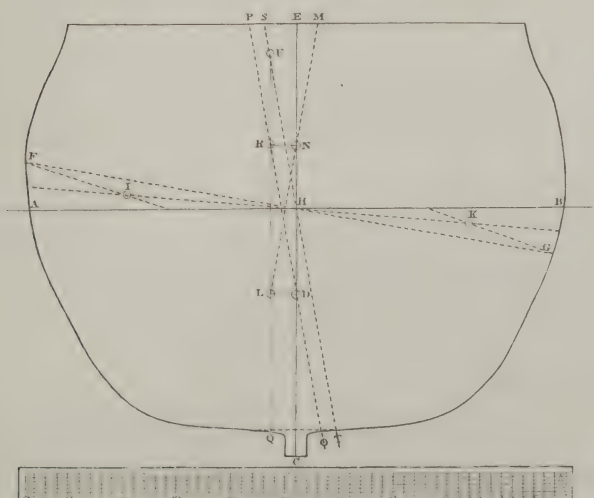


FIG. II. _ DISPLACEMENT, &c.



MACHINES for DRIVING and DRAWING of BOLTS.

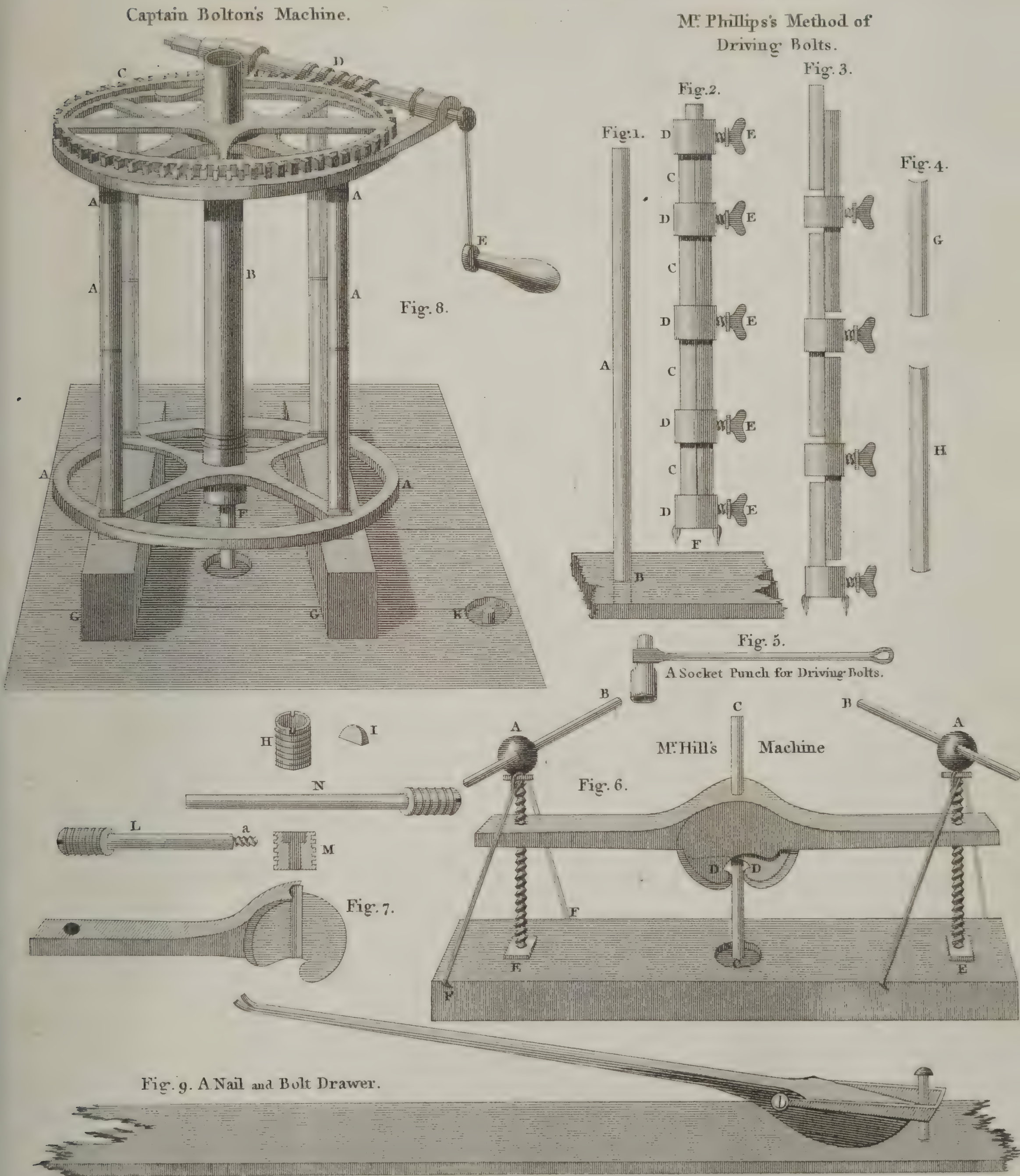


Fig. 4.
Circular Sterns

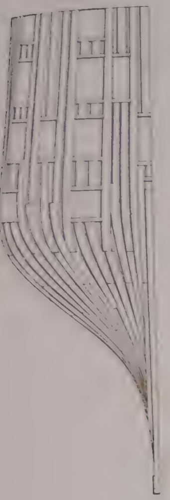


Fig. 3.

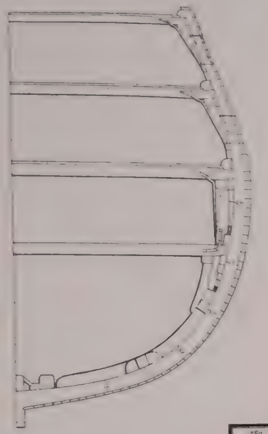
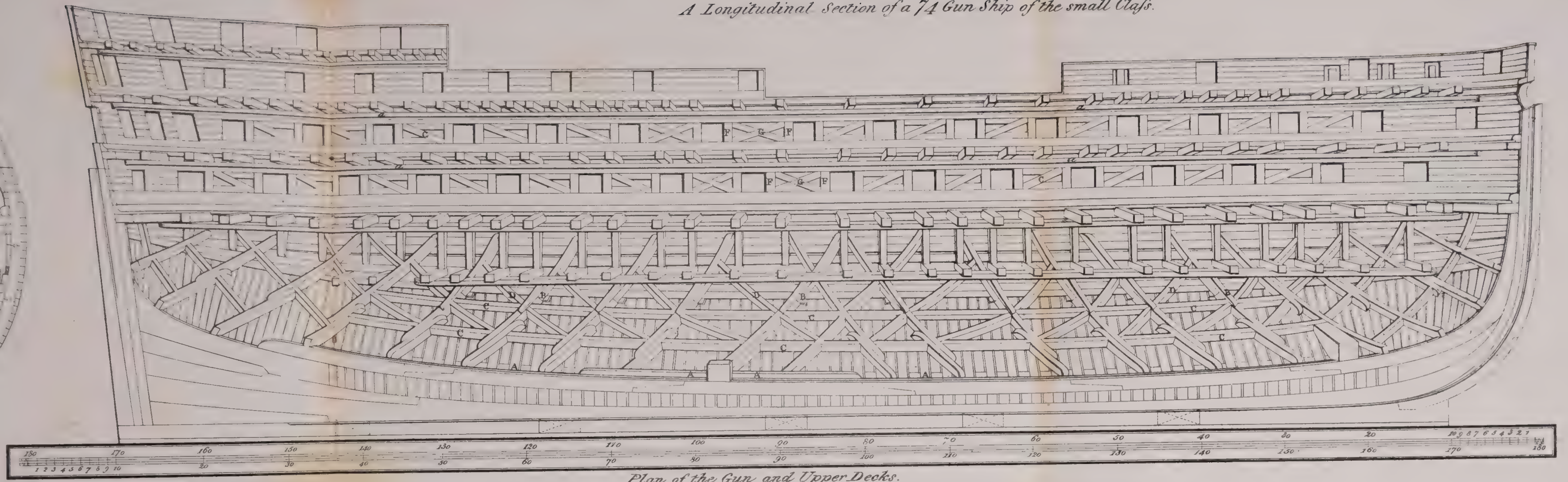


Fig. 1.

A Longitudinal Section of a 74 Gun Ship of the small Class.



Plan of the Gun and Upper Decks.

Fig. 2.

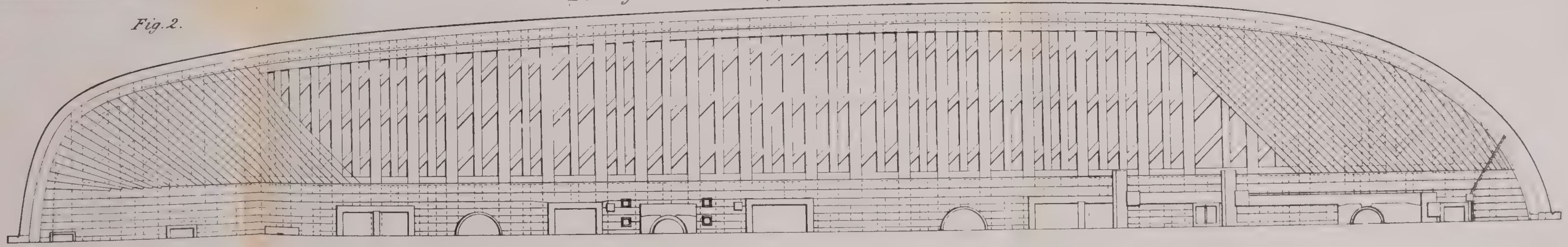
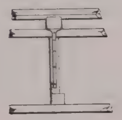


Fig. 6.

Fig. 5.



Drawn on Stone by G. Moorsom.

Printed by C. Hullmandel

Published by W. Simpkin and R. Marshall. April 1822.

PLATE. I.

Fig 1

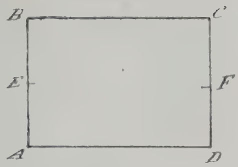


Fig. 2.

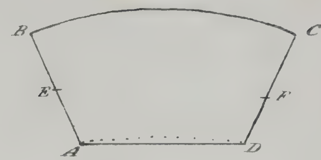


Fig. 3.

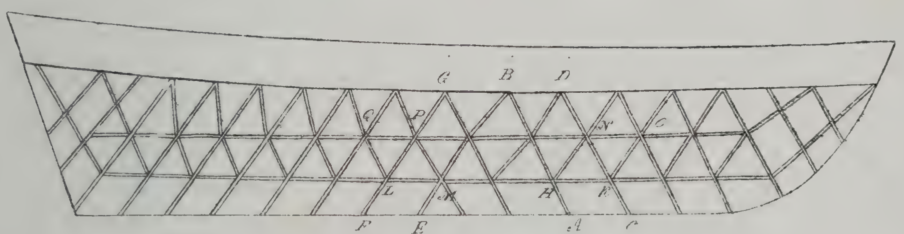
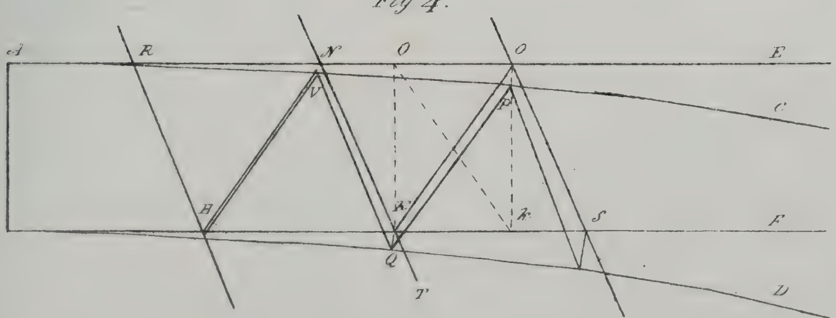


Fig 4.



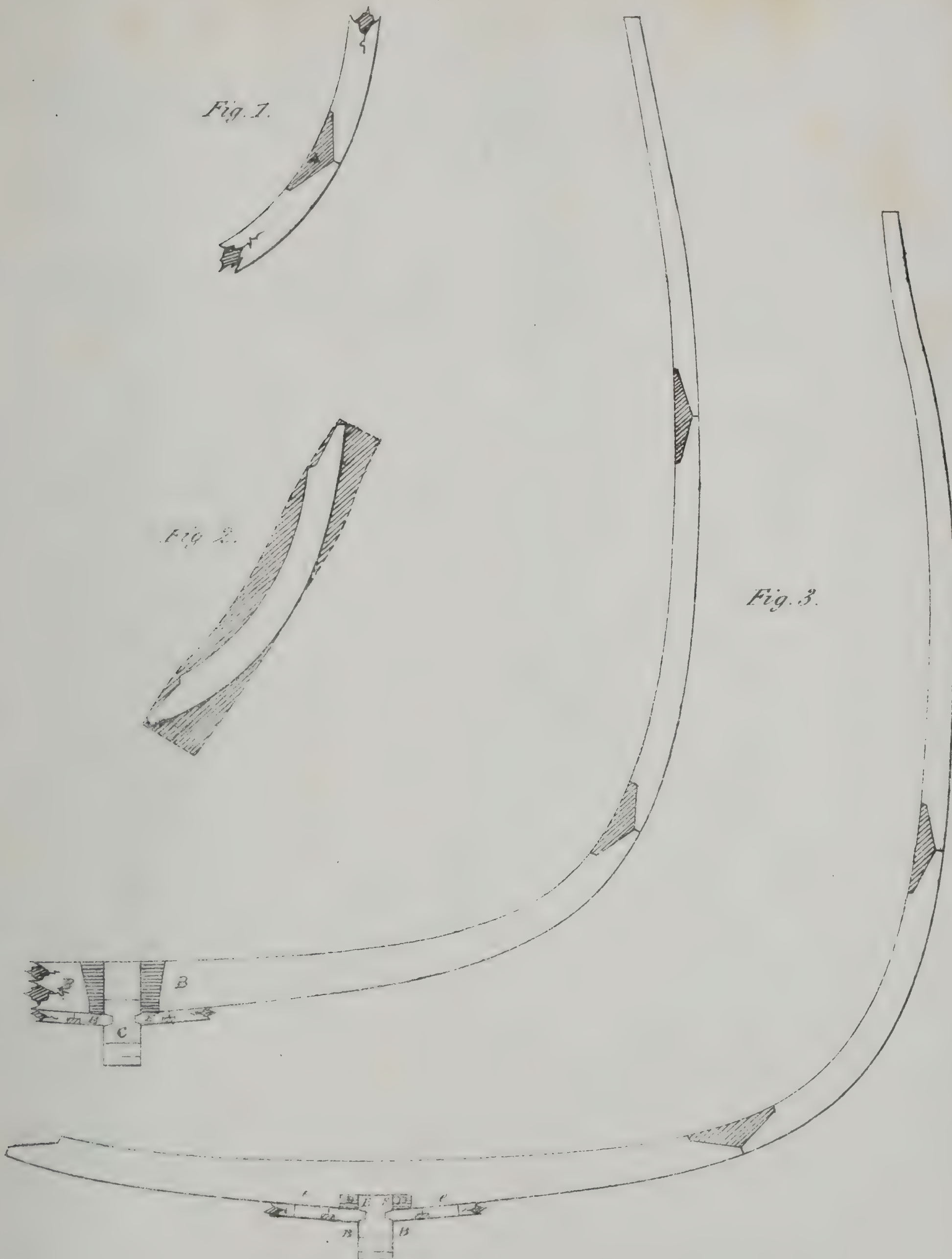


Fig. 1.
Fig. 2.
Fig. 3.
B
B
C
B
B

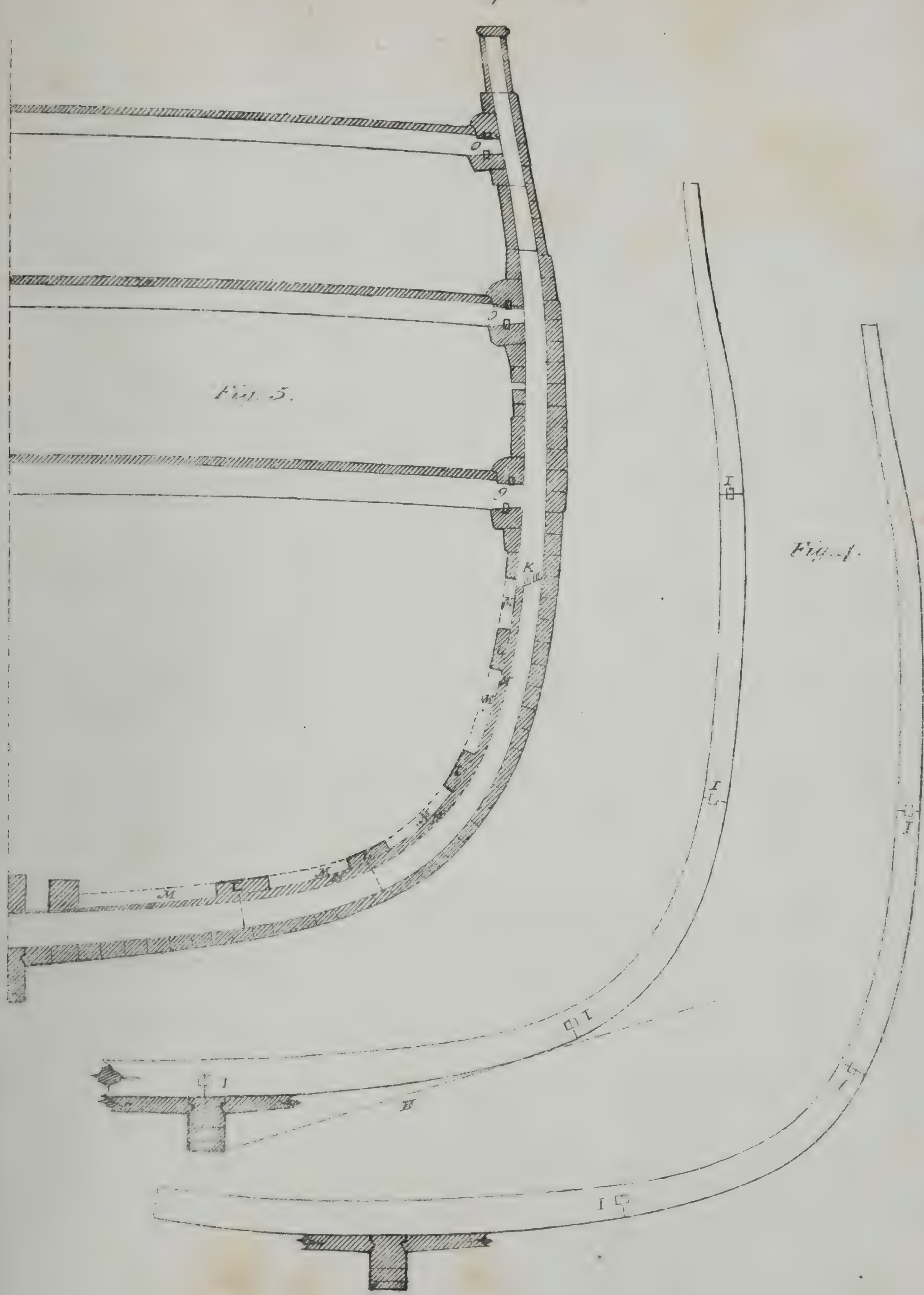


Fig. 5.

Fig. 4.

PLATE O.

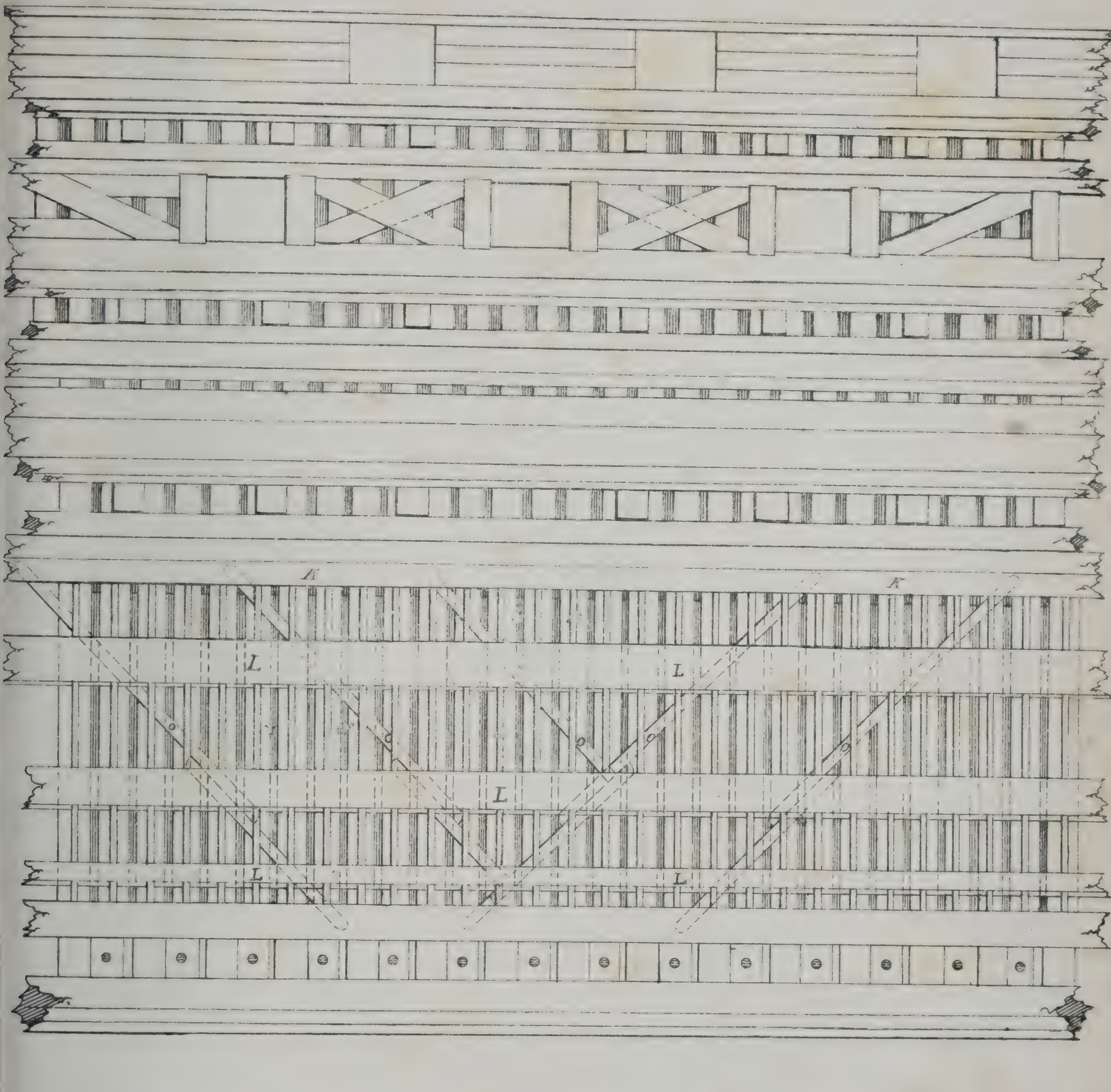


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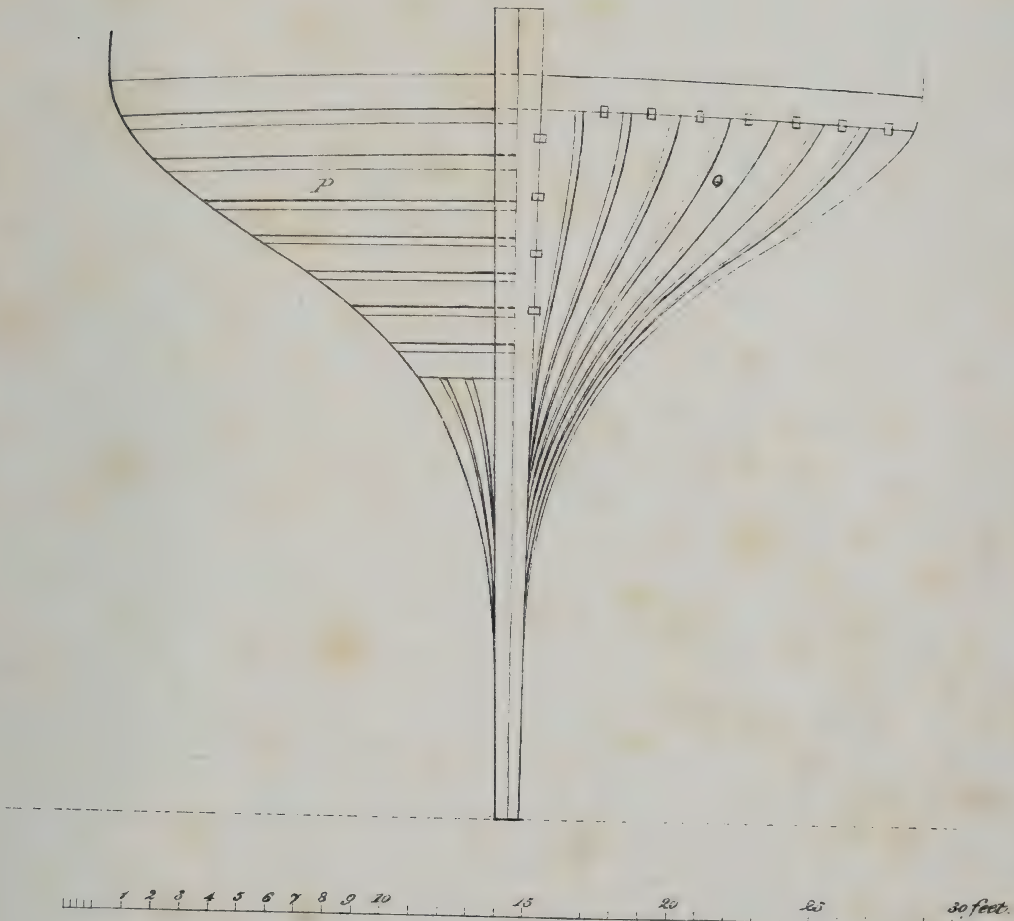
PLATE P.



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